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FORMERLY
ELECTRICAL EXPERIMENTER

WORK AND LEARN WHILE YOU SLEEP

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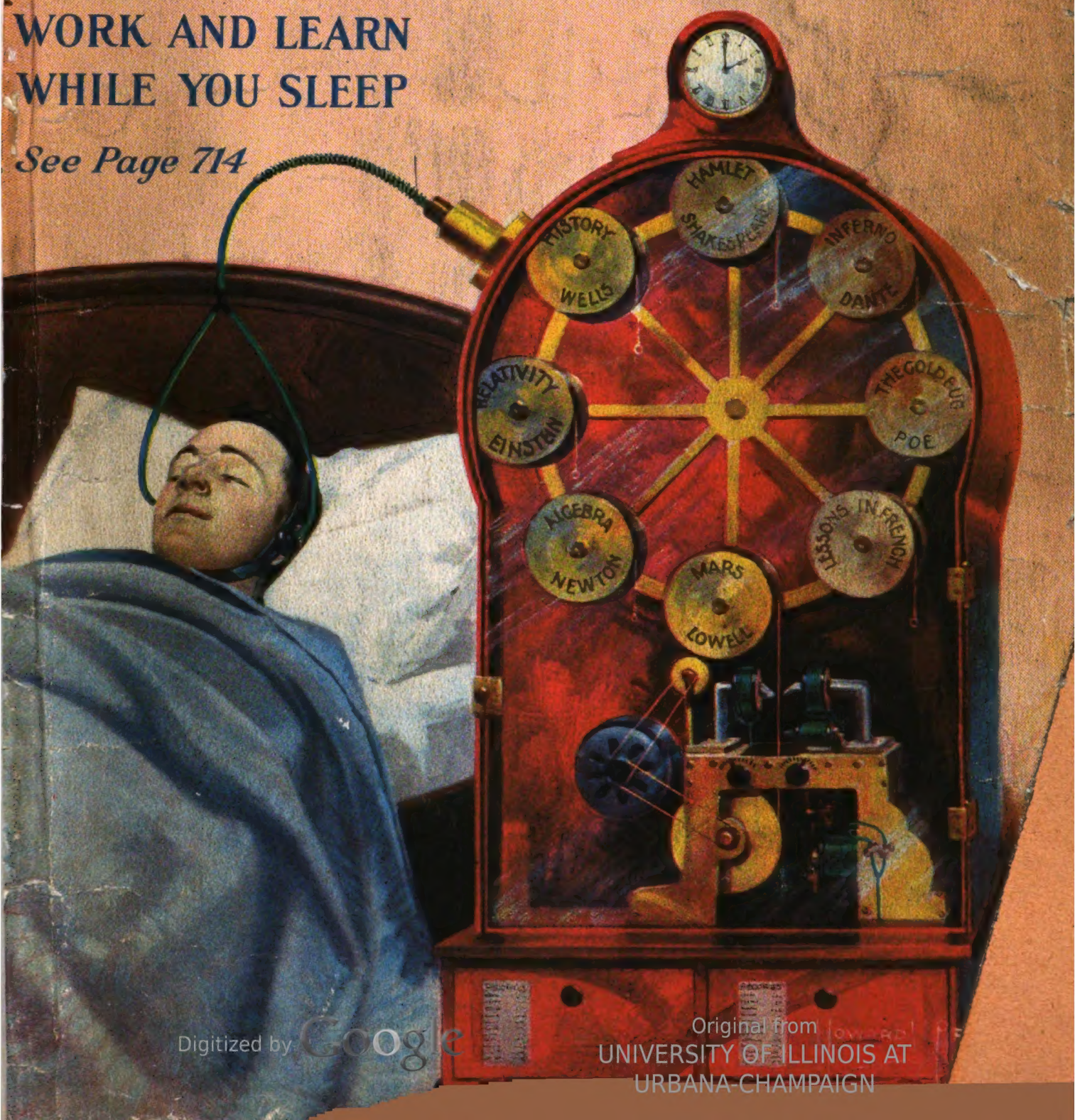

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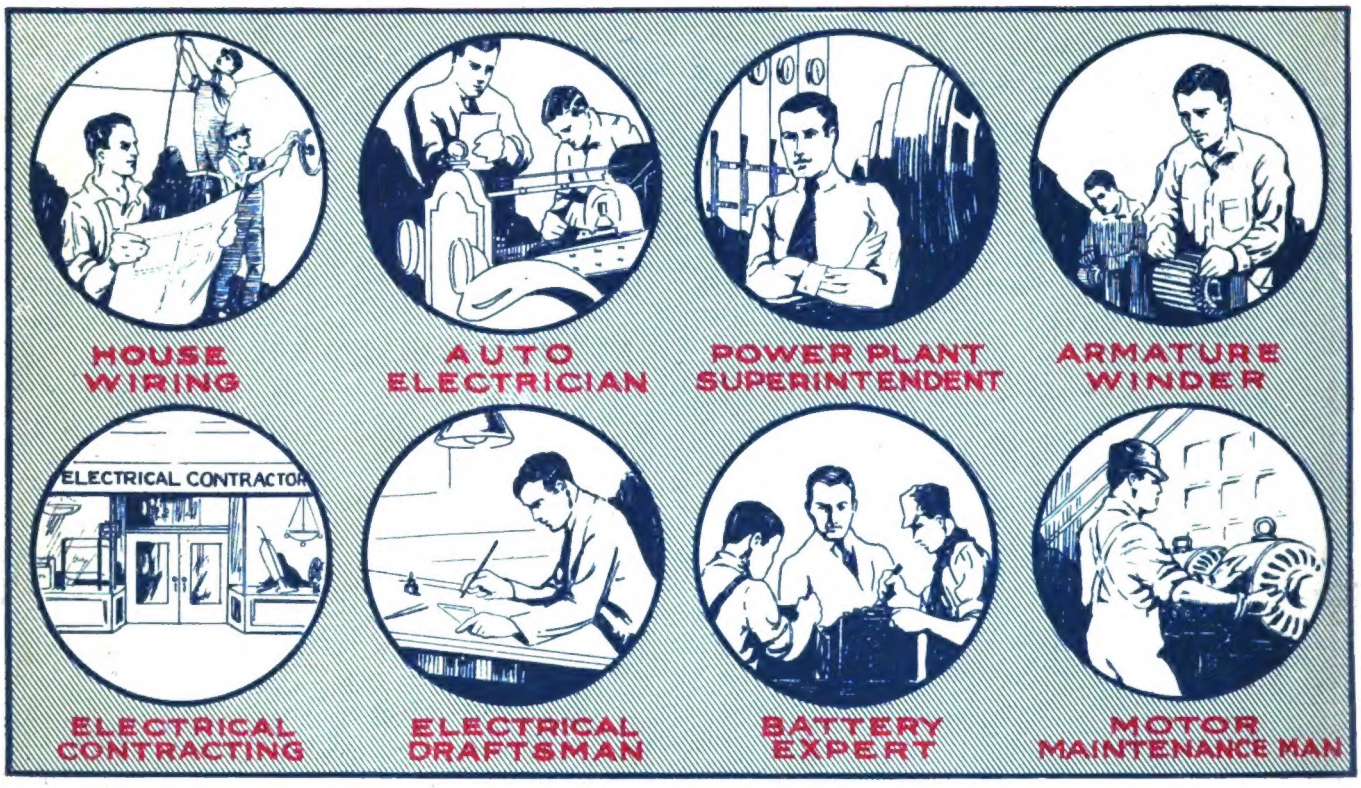

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Vol. IX
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Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
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December, 1921
No. 8

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Innovations in Sensations

CIVILIZATION, as we well know, brings with it a host of novel diseases as well as pleasures. The craving for pleasurable sensations, as the human race advances, becomes more and more pronounced, for reasons only imperfectly understood today. Among animals and insects rhythmical sensations such as those due to music are not at all developed, or very little. Music, altho heard perfectly by a horse or a dog, leaves but little impression upon them, altho certain *notes* will make a dog howl. Rhythmical music, however, will leave him unresponsive, whereas it will stir the human deeply. Dancing, another rhythmical expression, is unknown among all animals, man being apparently the only living being who can practice and enjoy it. Rhythmical sensations are enjoyed by all mankind; even the lowest aborigine has his tom-tom music and his sacred dance—crude to our understanding—but well developed nevertheless.

Music, as we understand the term, is of but recent origin. The ancient Egyptians, the Hebrews, the Greeks, had their so-called chants, but they were simple and uncomplicated. Tho rhythmical dancing was well developed among the Greeks; it was accomplished without the use of real music. Rhythmical beating of drums, or blowing of short horns, formed the sole accompaniment as a rule.

As it took the race several thousand years to learn and cultivate a taste for music, and as the onmarching civilization will most assuredly evolve new pleasurable sensations, one may wonder what the next development will be.

As a matter of fact it has arrived already. Its name is Color-music. Color-music simply transposes two of our senses. It substitutes the eye for the ear, but the rhythm remains. Every audible note has its complement in a certain color. If these colors are displayed before our eyes in the same periodical manner as ordinary music, we obtain the same sensation—or a greater one, if we combine color plus music. Few people as yet can appreciate color-music, it is still new and its technique is not perfected, altho we are already building "Color-organs" and the like.

Will we stop here? Not at all. We can still transpose the ear for the touch. The writer recently showed this in his Physiophone where ordinary phonograph music was transformed into electrical impulses, which latter were felt by the hands. There was of course here no audible music—nothing was heard—but the rhythm was faithfully preserved. Thus it was possible with but little practice to recognize different pieces of music, were they a march or a waltz.

How about the sense of smell? Can we transpose music into smells, or rather odors, scents or perfumes? To be sure it is possible, but it will be difficult to convey a sonata of odors to our audience. But with pipes scattered thru an auditorium and powerful blowers as the "odor-organ," it seems not so difficult. The trouble will be to find the proper odor for each note. Thus, to decide if A-flat is represented by jasmine, or violet, or attar of roses, may presumably be left to the future poet-musician.

This leaves us with the last of our senses—taste. Can we transpose music into taste? Why not? Our ever-ready servant electricity may solve the problem. We can already taste radio messages, so why not music? We know that placing two wires from a dry cell on the tongue gives us a sour sensation—taste. By using different metals, different tastes are had. Thus copper gives an acrid-metallic taste, silver a clean-sour taste, etc. Suppose we make a "comb" of many metals and conductors to each of which a wire is attached. The comb to be placed into the mouth so that it lies on the tongue. By a little experimenting we will readily transpose music into gustatory sensations—and not to make a pun—we will now be able to suit every taste!

H. GERNSBACK.

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5. Do you really understand the principles of alternating currents and alternating-current circuits—power factor, inductance, reactance, impedance, permittance and the like?
6. Are you familiar with the modern electron theory of electricity which now renders easily understood so many things about electricity that were obscure formerly?
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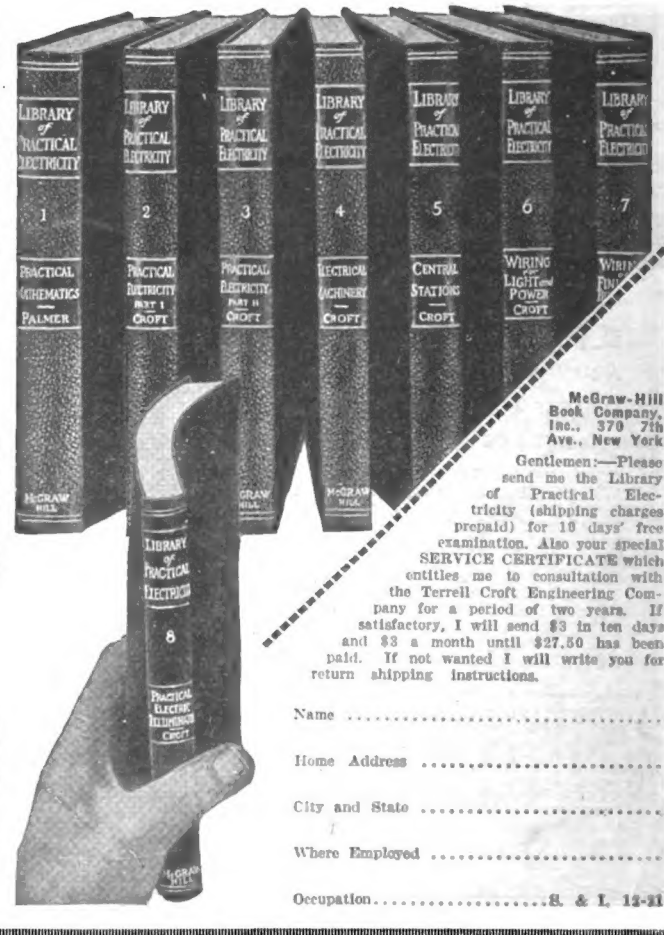

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Volume IX
Whole No. 104

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

DECEMBER
1921
No. 8

A New Color-Music Instrument

By EDWIN HAYNES

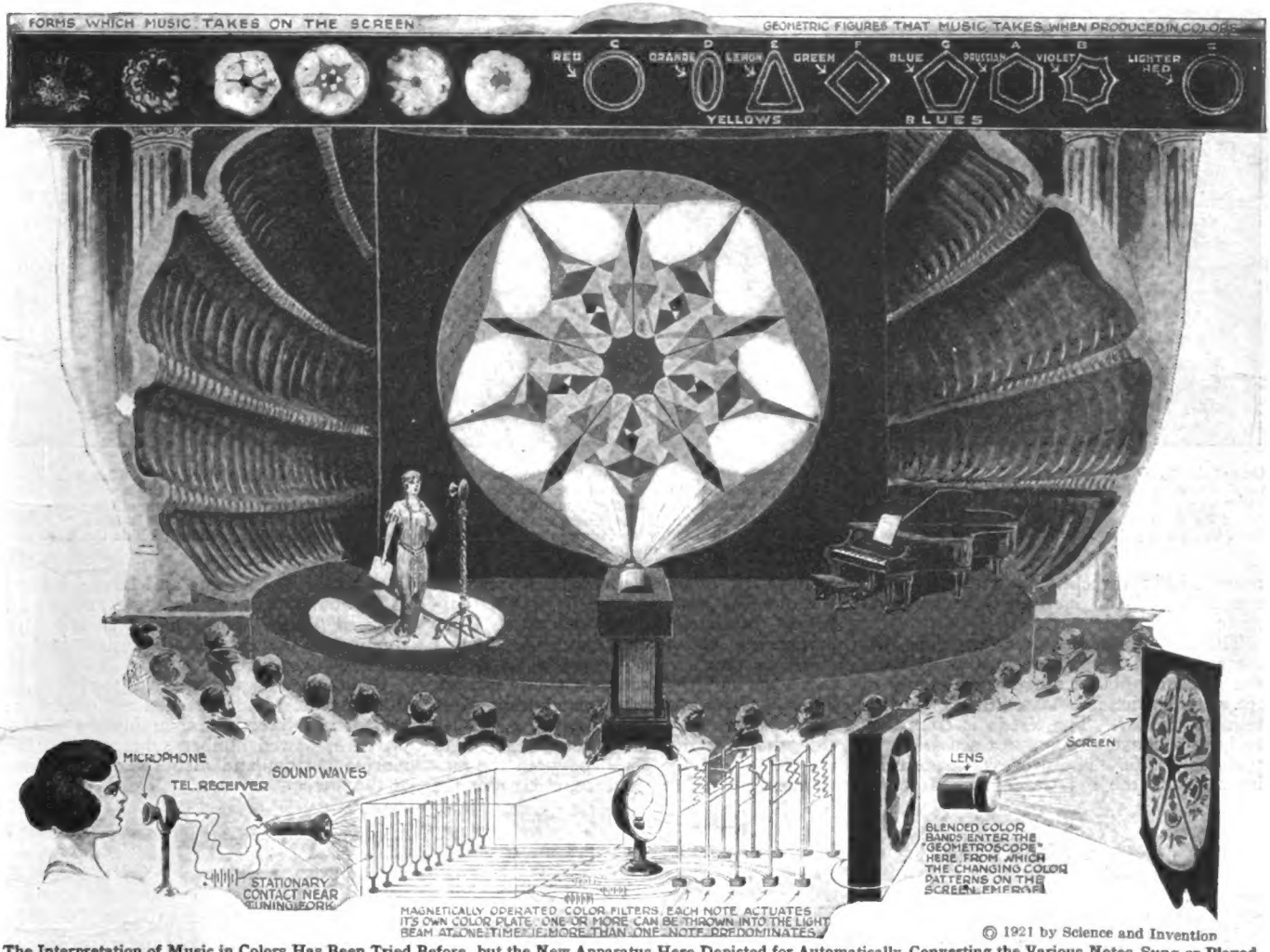
AN extraordinary instrument has been invented by William Maulsby Thomas, of Los Angeles, which produces what he terms *unison color-music*. He is an old investigator and the inventor of several important mechanisms and processes. His recent activities have been devoted to problems relating to color music and color photography.

The unison color-music instrument marks a great advance in all respects in the translation of music into colors. Its predecessor, the color organ, a ponderous, costly mechanism, is insignificant by comparison, with regard to the results obtained. The color organ projects upon a screen colors of the visual scale, corresponding to notes of the musical scale as they are sounded upon the keyboard manipulated by an executant. Its capacity is limited to the production in sequence of colors without form.

The new instrument is compact and comparatively inexpensive—so compact that it can be enclosed in a portable case. By adjusting relations between sound vibrations and light vibrations translations are made automatically, not only of music but of all kinds of sounds. An interesting feature of the unison color-music instrument is that it gives each note of the musical scale a distinctive geometric figure and definite color, so that when an orchestral performance is translated and projected upon a screen the several geometric figures assemble themselves into a sequence of symmetrical multicolored forms, of great variety and beauty.

The unison-color instrument, like many other important devices, is technically extremely simple and easily operated. A sensitive electro-microphone is placed on a standard near the singer or singers or the musical instrument or combination of instruments. In a theater or music hall, the microphone is connected by wire with the color music instrument, which is enclosed in a case about eighteen inches in each of its three dimensions, placed in the balcony just as is a projector for the production

(*Continued on page 786*)


FORMS WHICH MUSIC TAKES ON THE SCREEN
GEOMETRIC FIGURES THAT MUSIC TAKES WHEN PRODUCED IN COLORS
RED
ORANGE
LEMON
GREEN
BLUE
PRUSSIAN
VIOLET
LIGHTER RED
YELLOWS
BLUES
MICROPHONE
TEL. RECEIVER
SOUND WAVES
STATIONARY CONTACT NEAR TUNING FORK
MAGNETICALLY OPERATED COLOR FILTERS, EACH NOTE ACTUATES ITS OWN COLOR PLATE. ONE OR MORE CAN BE THROWN INTO THE LIGHT BEAM AT ONE TIME. IF MORE THAN ONE NOTE PREDOMINATES
LENS
SCREEN
BLENDED COLOR BANDS ENTER THE "GEOMETROSCOPE" HERE, FROM WHICH THE CHANGING COLOR PATTERNS ON THE SCREEN EMERGE

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The Interpretation of Music in Colors Has Been Tried Before, but the New Apparatus Here Depicted for Automatically Converting the Various Notes Sung or Played Has Just Been Perfected by a California Inventor. One of the Principal Uses for This Apparatus Lies in the Fact That the Deaf May "Hear." All That Deaf People Would Have to Do Would be to Learn the Color Pattern Alphabet Devised by the Inventor, and Then They Could Enjoy All the Subtle Blending of Musical Notes, Simply by Observation With Their Eyes. As Each Note or Chord Impinges Upon the Microphone, the Telephone Receiver Repeats the Sound Into a Closed Chamber, Containing Tuning Forks of Different Pitches; the Tuning Fork Which Responds to the Given Note Closes a Circuit Thru a Magnetically Actuated Color Filter. The Various Color Tones Then Pass Thru the Geometroscope and Appear on the Screen in Ever-changing Patterns.

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Electrolytic Destruction of the Teredo

THE U. S. Bureau of Fisheries is authority for the statement that an adult *teredo*, the pesky little borer that destroys thousands of piles yearly, is capable of producing approximately 100,000,000 eggs per season—in moderate climates the embryos can become free swimming within three hours after the eggs are laid, and the larvae reach the adult stage in thirty days.

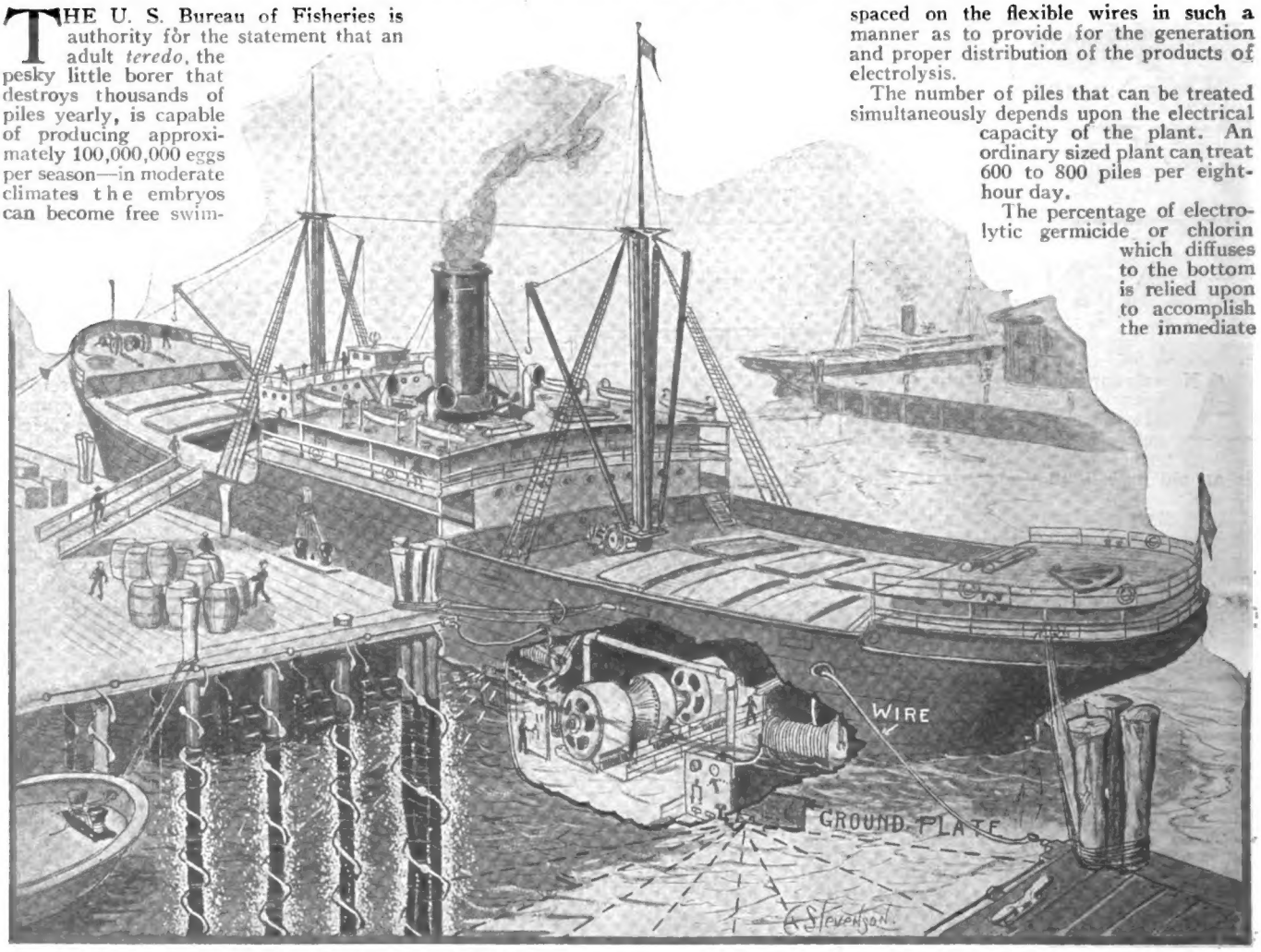
The anatomy of the teredo provides that the only food it can use must come from the infusoria obtained from its supply of sea water, which is obtained thru one of its tails or siphons. The teredo is compelled to have a constant supply of sea water to sustain its life. The process we describe impregnates the sea water with a strong solution of chlorin, and kills the teredo.

A floating plant, because it can be transported, is adaptable for general use, but permanent wiring can easily be applied when so desired. A generator of heavy amperage and low voltage capacity is used. Flexible wires are dropt from lateral wires fastened to the wharf capping, either alongside or with a few turns taken around the piling. In the depth between the marine bottom and the surface, electrodes are spaced on the flexible wires in such a manner as to provide for the generation and proper distribution of the products of electrolysis.

The number of piles that can be treated simultaneously depends upon the electrical capacity of the plant. An ordinary sized plant can treat 600 to 800 piles per eight-hour day.

The percentage of electrolytic germicide or chlorin which diffuses to the bottom is relied upon to accomplish the immediate destruction of the eggs and larvae always to be found in large numbers around all infested piling. The same in solution accomplishes the immediate destruction of the adult wood borer.

Reattack and the necessity of repetition of treatment is guarded against by the periodical microscopic examination of test pieces of sawed lumber submerged to the marine bottom and also spiked to piling at the low water mark.



One of the Greatest Pests in the Marine World Is That Pesky Little Borer, the "Teredo," Which Destroys Thousands of Wooden Piles Annually. This New Electrical Method of Exterminating the Teredo in the Vicinity of Wooden Piling Is Said to be Very Successful. The Electric Current Supplied from the Special Dynamo Plant on Board the Ship, Especially Fitted up for the Purpose, Is Conducted Along the Insulated Wires Leading to the Top of the Piling. Thence It Passes Down Along the Bare Wires Wound Around the Piling, and Finally Returning Through the Water to the Metal Ground Plates, or Hull of the Ship if It Is Made of Steel, Thus Completing the Circuit. The Electrical Action Along the Wires Encircling the Piling Liberates Chlorine Gas Which Kills the Teredo as Well as the Eggs and Larvae. 600 to 800 Piles Can be Treated per Day.

Sunset as a Clue to a Hurricane

By S. R. WINTERS

The splendor and enchantment of the sunset are proverbial—one poet comparing the glowing hue to a turquoise—but it remained for R. M. Dole, an observer of the United States Weather Bureau, to discover that a lurid sunset is a clue to the presence, either near or remote, of a tropical storm. Sea swells, swiftly moving upper clouds, and an increased velocity of the wind, are common warnings of an approaching storm, but a fire-colored sunset frequently precedes these by twenty-four to forty-eight hours.

Wireless communication is an agency for fixing the location of tropical and local disturbances, but owing to the small diameter of some storms they may be undetected by vessels equipped with radio apparatus. Hence weather observers look for other indications, and while searching for signs at Wilmington, N. C., the representative of the Weather Bureau established the conclusion that a lurid sunset is a token of atmospheric disturbances. For a period of three days the brilliancy of the sunset was markedly evident. These warnings proved correct—a visitation of a wind with a velocity of 33 miles an hour ultimately spent its force in the vicinity of Wilmington. At the beach the wind was converted into a gale traveling at 60 miles an hour—blowing down a house—and captains of vessels reported its speed at sea to be 90 miles an hour.

The lurid painting following the descent of the sun into the "valley" is of brief duration—and the intensity of its fire-like hue seems to be gaged by the strength of the tropical disturbance. The awe-inspiring sunset, admired by the layman, is not to be confused with the luridness of the color when storms are spending their fury. Bright-colored sunsets are traceable to a variety of causes—volcanic dust, cold and warm waves, and approaching circular storms. The fire-colored glow during the hurricane season may combine with other signs—such as clouds moving from uncommon directions and possibly sea swells—to make unmistakable the warning of the existence of a tropical disturbance.

Storms of small diameter may be revealed in no other way, until their fury is present with such force, as to render safeguards useless. Hence weather observers in the future will watch for this valuable clue especially at beaches where ample harbors are not always available. The exposure of the congested beaches is a condition suggesting utmost precautionary measures to urge the floating population to repair to safety before the hurricane, possibly attended by strong squalls, and torrents of rain jeopardize life.

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Insects as Jewelry

By Dr. ERNEST BADE

"FASHION is Law," and man follows its demands without question. This most peculiar and changeable of rulers holds its sway also over both the organic and the inorganic worlds, altho as far as animals and plants among themselves are concerned, it is unknown. The bird still builds its nest as in former generations, the lily on the field still clothes itself during the flowering season with the same gorgeous material, which is neither spun nor woven, the same it was in the time of Solomon. But where plants and animals come in contact with man, where they come under his influence, his protection, his care, there they are thrown under the bane of fashion.

The various people of South America have enjoyed ornamental beetles for ages, and in the tropical regions with their incomparable profusion in metallic and glittering beetles, such use probably originated. These animals with their hard outer skin of chitin are admirably adapted for this purpose, for the chitin is a kind of a nitrogenous "wood," which is attacked with difficulty by acids, and does not melt like horn in the flame, but only glows. It is practically indestructible, and its surface is often beautifully colored.

Some of the ground beetles glow with a golden shimmer; others, the squareheads, also known as hammer-heads or flat-headed borers, are provided with thousands of emeralds, and the Chrysomelid shine in fairy metallic colors. And in addition how different is the surface of the wing covers of the various beetles, dotted, spotted, ribbed, and pitted, spined, knobbed, flattened, and rounded; some are light or brightly colored, while others are provided with delicate tints of the most varied hues.

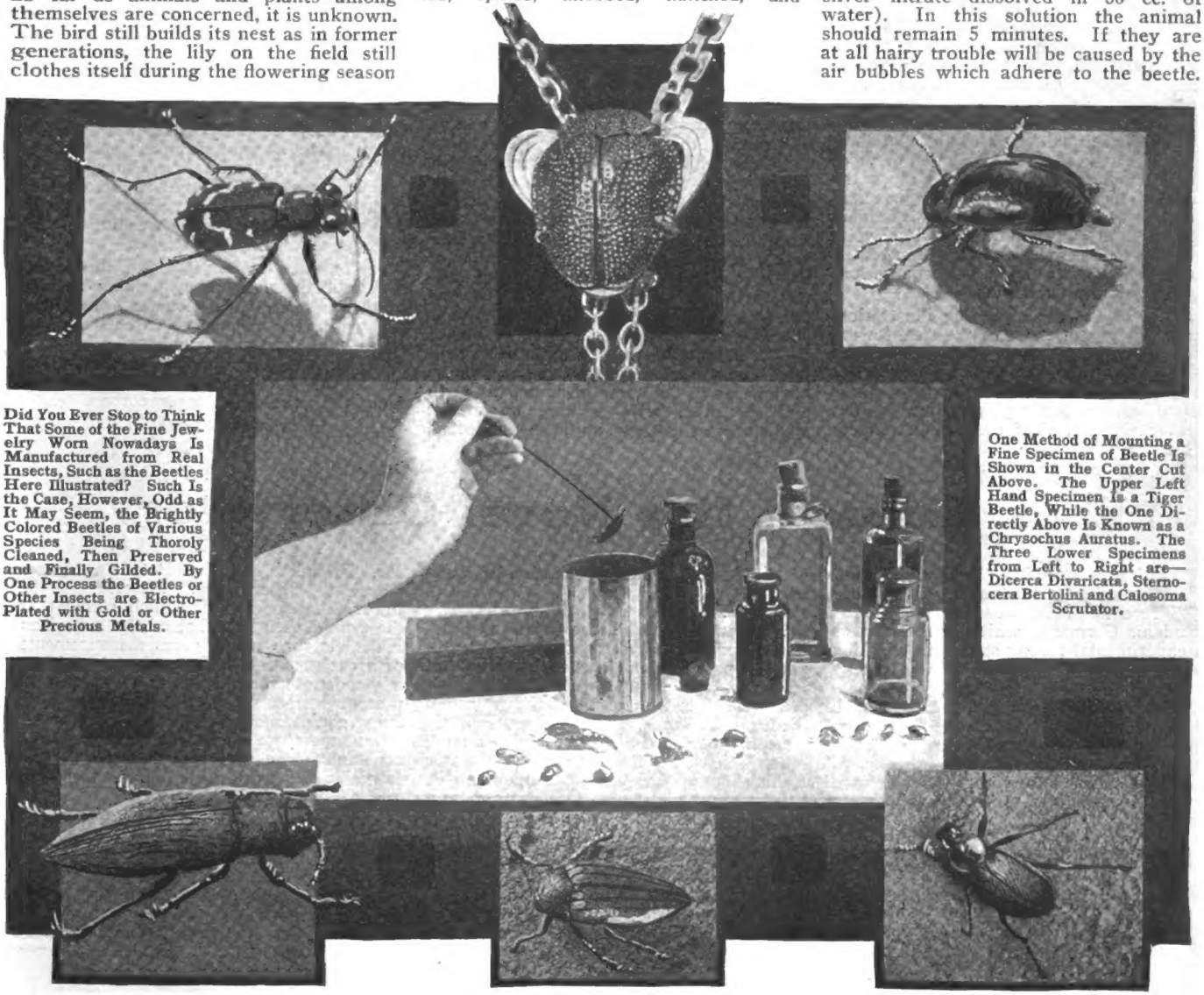
The European beetles suitable for ornamental purposes are used in their natural condition. Hoplia coerulea, a French bettle, has silvery colored wing covers. The two French rose beetles, Cetonia aurata and Cetonia speciosissima, are also much in demand for this purpose. Asia provides us with the Indian species, Sternocera, especially Sternocera aquisignata, which has an emerald green thorax with darker wing covers, the latter being not quite coppery in appearance. South America gives us numerous ornamental snout beetles, while Australia sends us many species of Anoplognathus.

These wonderful beetles are simply introduced into a brooch or used as a stick pin, but fashion decrees that all kinds of native insects can be used as well if they are plated.

When caught the beetles are placed in the poison bottle, after which they are dried in the air. A piece of thread which has been weighted is attached to the insect, and the beetle is then submerged in a solution of silver nitrate (1 gr. of silver nitrate dissolved in 30 cc. of water). In this solution the animal should remain 5 minutes. If they are at all hairy trouble will be caused by the air bubbles which adhere to the beetle. In this case the insect is first suspended in denatured alcohol where it is gently moved about until all of the air bubbles have risen to the top. Then it is placed in the silver solution. When this operation has been accomplished the beetle is hung in the sun to dry.

Now a large glass jar is taken (a tin can with a cover will do), and after placing some iron sulfid in a small dish and covering it with a dilute solution of sulfuric acid, it is placed in this large receptacle, the beetle is suspended over the small dish and the jar loosely stoppered and placed where the fumes of hydrogen sulfid, which are generated by the iron and the acid, are least likely to be noticed. The fumes change the soluble silver salt into the insoluble silver sulfid. The gas must act until all of the silver nitrate has been changed to the sulfid. Then the beetle is slightly washed in water and it is ready for the plating solution.

(*Continued on page 776*)



Did You Ever Stop to Think That Some of the Fine Jewelry Worn Nowadays Is Manufactured from Real Insects, Such as the Beetles Here Illustrated? Such Is the Case, However, Odd as It May Seem, the Brightly Colored Beetles of Various Species Being Thoroly Cleaned, Then Preserved and Finally Gilded. By One Process the Beetles or Other Insects are Electro-Plated with Gold or Other Precious Metals.

One Method of Mounting a Fine Specimen of Beetle Is Shown in the Center Cut Above. The Upper Left Hand Specimen Is a Tiger Beetle, While the One Directly Above Is Known as a Chrysochus Auratus. The Three Lower Specimens from Left to Right are—Dicerca Divaricata, Sternocera Bertolini and Calosoma Scrutator.

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Oddities of 1,000,000 Volt Transmission

ONE million volts of alternating potential may be not such an uncommon quantity in the near future, when electrical engineers have worked out some of the details met with in applying such a tremendous electric pressure as this for transmitting energy over wires. The electrical experts of the General Electric Company recently demonstrated the transmission of power at a potential of 1,000,000 volts over a short distance, at Pittsfield, Mass. Previously it was thought that about one quarter million volts, which is used at present, represented the practical limit in high potentials for transmission lines, owing to the considerable loss due to brushing or *corona* as it is termed by engineers. High voltage transmission lines carrying potentials of 30,000 volts or more invariably show a blue glow all along the wires at night, and one of the principal problems which the engineers at Pittsfield tackled, in trying to utilize 1,000,000 volts for power transmission, was the reduction of this corona or brush discharge loss to an economical minimum.

Fig. 1 in the accompanying illustration, shows the gigantic size of the steel towers and insulators necessary to carry a 1,000,000 volt transmission line. The three wires shown are intended for a three-phase system. As recently pointed out by Dr. C. P. Steinmetz, chief consulting engineer for the General Electric concern, as well as by Mr. David B. Rushmore, one of the staff of chief engineers of the same concern, the conductors on the 1,000,000 volt transmission system will have to be separated about 100 ft. to prevent leakage of electrical energy between the wires, and the wires would also have to be supported at least 100 ft. above the ground to prevent leakage, etc. The insulators used for high voltages such as this are made up of a number of porcelain disks having their under surface ribbed to increase the length of leakage surface.

As Mr. Rushmore further stated, "If a man should get too near to a wire carrying a million volts with his umbrella up, he might get into trouble. Of course, in practise, the wires would have to be suspended high enough to remove any danger, but here again is an economic drawback to tensions of this magnitude. If a man stood beneath the wires and were insulated from the earth, his hair would stand right up in the direction of the wire. If his feet were in direct contact with the earth, he would probably notice a tingling sensation." If a man should stand within 30 to 40 ft. of such a 1,000,000 volt line and held a well insulated lamp socket, as shown in Fig. 2, having one of its wires grounded to earth and the other wire sticking up in the air, sufficient energy would be collected, due to leakage thru the air, to light the lamp.

We have not read in the reports concerning the 1,000,000 volt transmission scheme, as to what would prevent a person from stealing electrical energy from such a system, in the manner shown at Fig. 3. It is a well-known fact that, if we place a wire parallel to a telephone or electric power circuit for a short distance, the fluctuating electric currents in such a circuit will induce in the wire running parallel to it, a secondary current. The distance separating the original transmission circuit from the secondary or induction circuit, will be greater the higher the voltage in the first or energizing circuit. Thus it is conceivable, that a person might have a wire running parallel to such a high potential line either on the ground, on a roof, or even inside a building and pick up sufficient electrical energy to light lamps and do his washing. Who is going to meter his wattage?

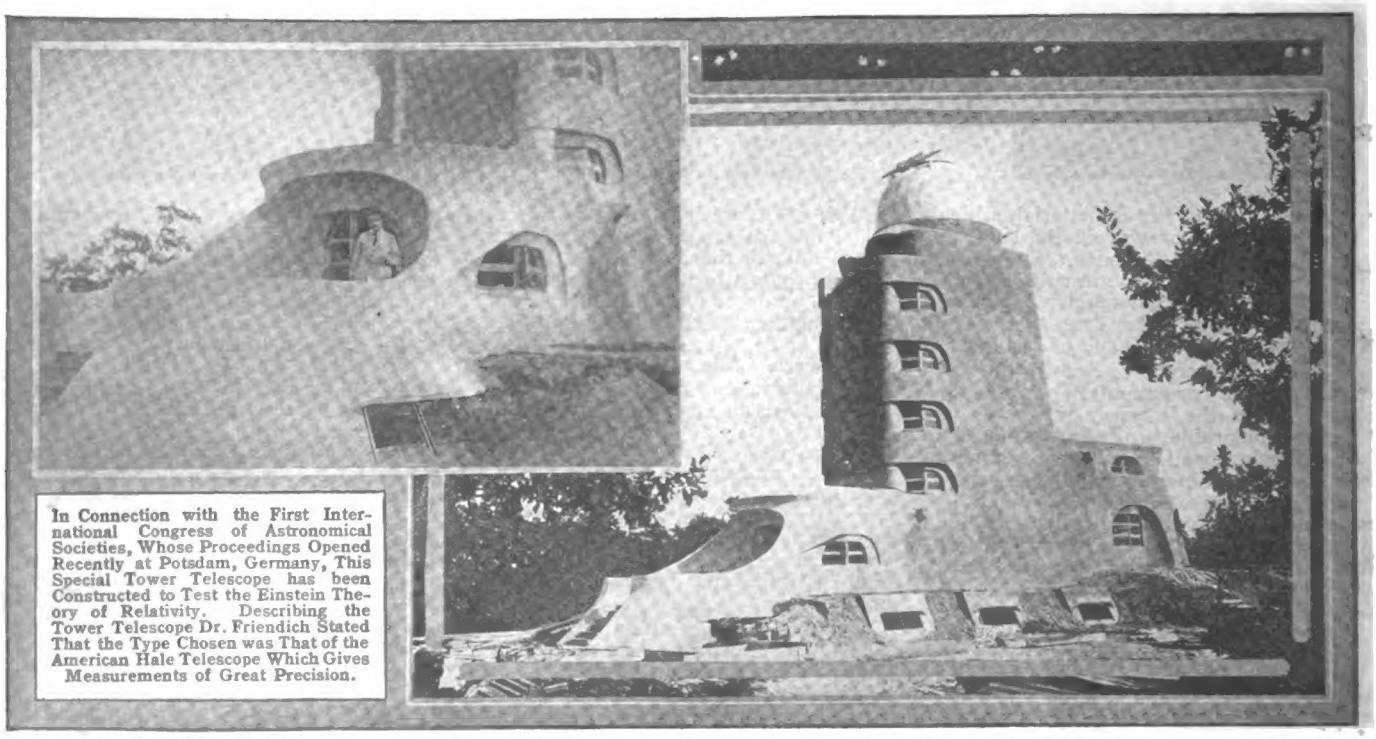
As outlined by experts and illustrated at Fig. 4, there are many peculiar aspects of the question, when it comes to handling such voltages. The more rarefied air becomes, the better it conducts. At high altitudes it is easier for the current to use the air as a conductor and break away from the wire in a larger corona. This

(*Continued on page* 775)

Prof. Einstein Has Novel Observatory

THE accompanying photographs show the unique astronomical observatory recently built at Telegraph Hill, Potsdam, Germany, which will serve as an experimental testing station in checking up the theory of relativity worked out by Professor Einstein. Here the great master of astronomical mathematics will study the heavens as they have never been studied before, in an effort to prove the successive points in his new theory of relativity. This observatory will be used also as an important experimental station of the Astro-Physical Institution of Potsdam.

In connection with the First International Congress of Astronomical Societies, whose proceedings opened recently at Potsdam, a special tower telescope had been constructed to test the Einstein theory of relativity. Professor Einstein himself attended the Congress, and among other scientists present were Professor Eddington, of Cambridge, Father Cortie, S.J., of the Stonyhurst Observatory, and Dr. Friendich, of the Potsdam Astro-Physical Observatory. Describing the tower telescope Dr. Friendich stated that the type chosen was that of the American Hale telescope which gives measurements of great precision. The coelostat rests on a wooden tower, 46 ft. high, encased in a stone tower, and at the base there is a fully equipt modern physical laboratory, the temperature of which is maintained constant. The structural design of the tower is the work of a Berlin architect, Erick Mendelson.



In Connection with the First International Congress of Astronomical Societies, Whose Proceedings Opened Recently at Potsdam, Germany, This Special Tower Telescope has been Constructed to Test the Einstein Theory of Relativity. Describing the Tower Telescope Dr. Friendich Stated That the Type Chosen was That of the American Hale Telescope Which Gives Measurements of Great Precision.

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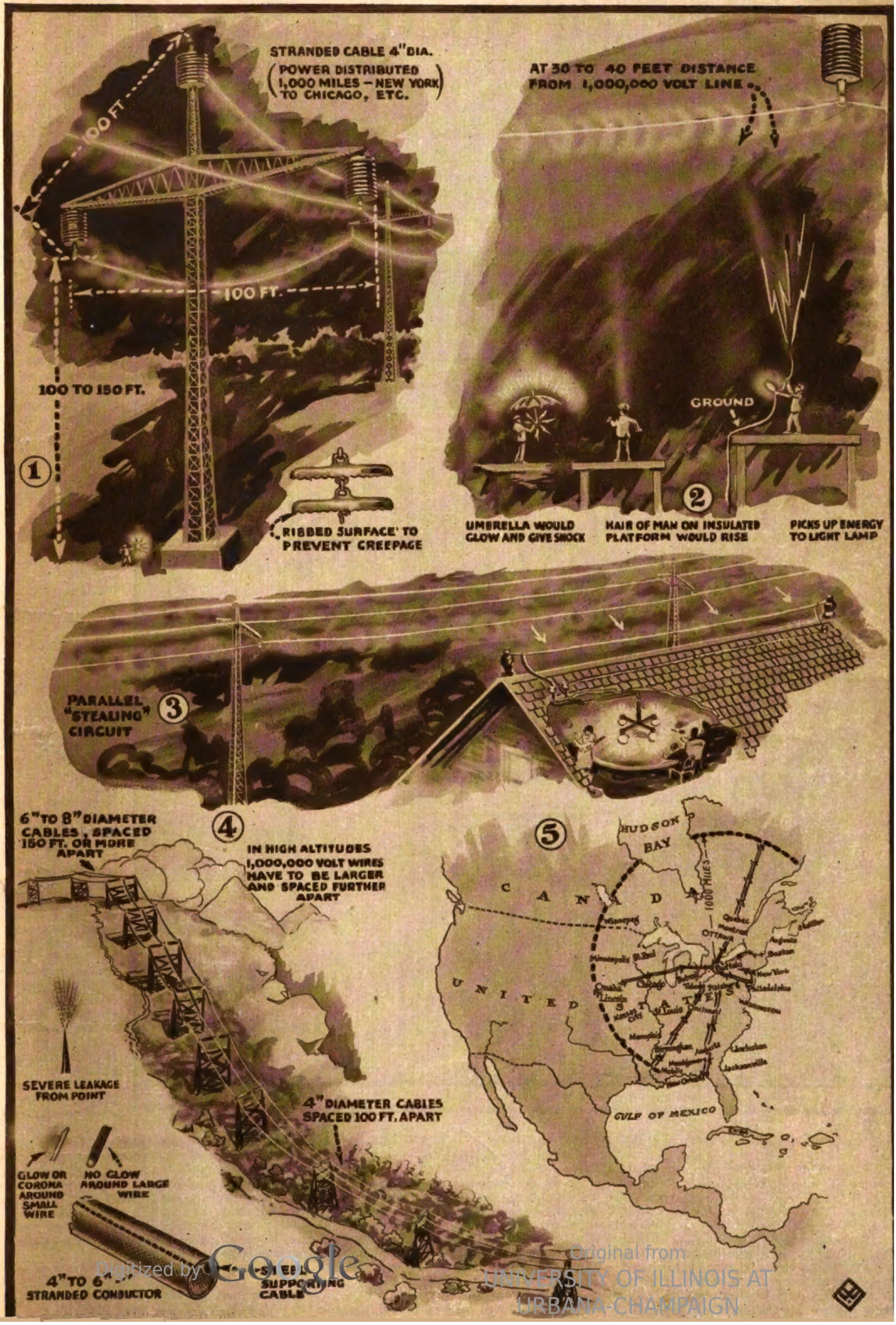
STRANDED CABLE 4" DIA.
(POWER DISTRIBUTED 1,000 MILES – NEW YORK TO CHICAGO, ETC.
100 FT.
100 FT.
100 TO 150 FT.
1
RIBBED SURFACE TO PREVENT CREEPAGE
AT 30 TO 40 FEET DISTANCE FROM 1,000,000 VOLT LINE
GROUND
2
UMBRELLA WOULD GLOW AND GIVE SHOCK
HAIR OF MAN ON INSULATED PLATFORM WOULD RISE
PICKS UP ENERGY TO LIGHT LAMP
PARALLEL "STEALING" CIRCUIT
3
6" TO 8" DIAMETER CABLES, SPACED 150 FT. OR MORE APART
4
IN HIGH ALTITUDES 1,000,000 VOLT WIRES HAVE TO BE LARGER AND SPACED FURTHER APART
SEVERE LEAKAGE FROM POINT
4" DIAMETER CABLES SPACED 100 FT. APART
GLOW OR CORONA AROUND SMALL WIRE
NO GLOW AROUND LARGE WIRE
4" TO 6" STRANDED CONDUCTOR
STEEL SUPPORTING CABLE
5
HUDSON BAY
CANADA
1000 MILES
OTTAWA
UNITED STATES
GULF OF MEXICO

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Science on the Stage

By ERIC A. DIME

COLORED LIGHTS CHANGE STAGE SCENE

ARE the present-day methods of changing scenery on a theatre stage soon to become things of the past—to take their places beside other antiquated devices and customs that have given way to the rapid march of progress? This may be difficult to answer at the present time but it looks as if the trend of events were heading that way.

We are led to this belief after witnessing a scene shown in the "Greenwich Village Follies, 1921," now current at the Shubert Theatre, New York. It is an episode called "When Dreams Come True," played by Richard Bold and Rosalind Fuller. This is known as a transformation scene and it is one of the most remarkable novelties of the stage ever introduced. It opens up new vistas into the land of make-believe and it puts within the reach of the drama of the future, possibilities never attempted or accomplished until the present time.

The scene in question opens with two young lovers on the stage. They are singing the song "When Dreams Come True." The lover tells his sweetheart of a land where romance reigns—the dwelling place of lovers true. Both of the young people wish that they lived in this land of Elysium where happiness is found on every side. The scene in which the lovers first appear shows the interior of a fashionable salon.

At the conclusion of the song and in the fraction of a second, the scene changes. The audience now sees a beautiful and enchanting garden, bathed in the soft glow of a full moon. The lovers stand under a dome supported by pillars, representing the Temple of Love. In the rear one sees the massive walls of the temple. Again there is an instantaneous change of the scene and the lovers find themselves in the salon. During this transformation even the costumes change in appearance.

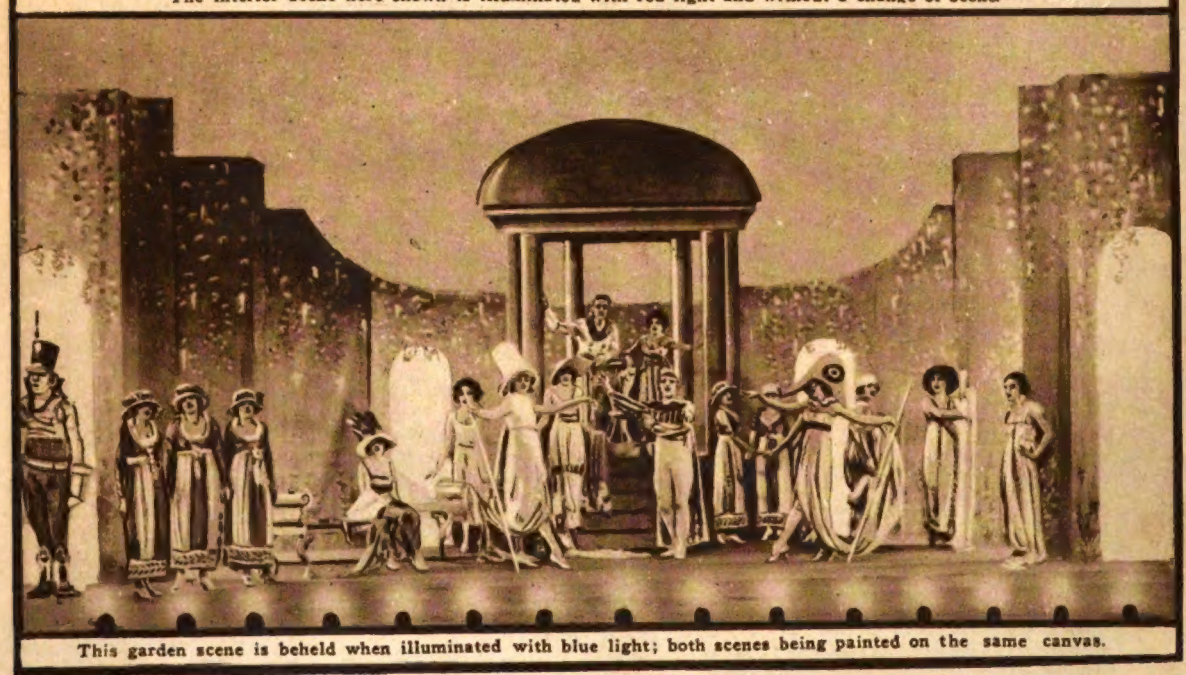
All these changes are accomplished without the shifting of a foot of scenery on the stage, without lowering the proscenium curtain and without darkening the theatre. On the other hand the transformation is accomplished by means of harmonious combination of light, color and design. The work is the creation of Nicolas V. de Lipsky, a young Russian artist who has devoted a great deal of his time experimenting with photography and the use of colored lights on superimposed scenic paintings.

Mr. de Lipsky is able to produce the transformation scene by having two or more pictures painted on the same prop. Then by flooding the canvas with certain colored lights, used on the stage, some of the colors on the canvas will be visible while others are completely obscured. As a matter of illustration it might be mentioned that under a red light the red color on the canvas becomes white and the blue in the painting a decided black. Under a blue light the red on the prop becomes black and the blue white. By a careful study of shades and colors and the effect on these of various colored lights, Mr. de Lipsky has been able to work a combination that gives separate and distinct scenes on the same canvas. To change from one scene to another it is only necessary to switch off a set of electric lights of one color and switch on a set of another color. This, of course, is done in a fraction of a second and naturally appears a decided mystery to the audience, who may not be familiar with the science of light and colors.

The transformation scene can be carried so far that even the dramatis personae may be made invisible on the stage in the

(Continued on page 746)

The interior scene here shown is illuminated with red light and without a change of scene.—



This garden scene is beheld when illuminated with blue light; both scenes being painted on the same canvas.

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New York's Musical Comedy Success, "The Music Box Review," Boasts of a Remarkable "Pearl Ballet." Each Pearl Is Treated With Radium Luminous Paint.

PHOTOS BY APEDA

When the Lights are Winked Out, the Audience Beholds the Startling Scene of the Ballet Members Outlined in Glowing Pearls.

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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

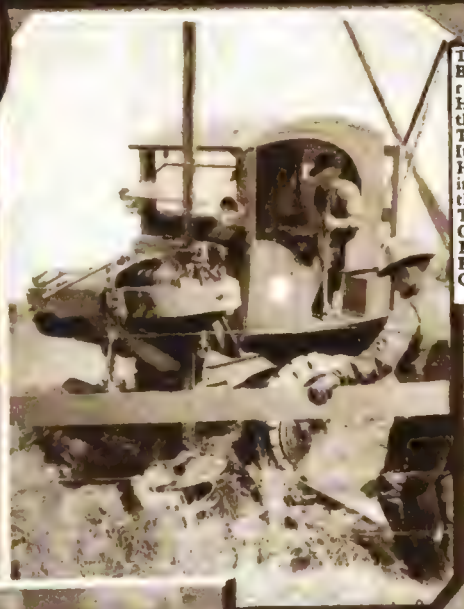
Science in Photos

The Laryngaphone Eliminates the Mouthpiece and in Its Place a Transmitter is Placed Against the Larynx When Speaking, so That the Voice Vibrations of the Throat Affect it.

The Photo Above Shows the "Oral" Water Level Recorder by Means of Which the Level of Water is Recorded by a Phonograph Actuated in a Very Novel Manner Over a Telephone Wire. One of the Important Things to Know at All Times about Hydro-Electric Plants and Reservoirs is the Exact Height of Water in Storage.

Miss Velma Tilden, of San Francisco, is Shown Attempting to Cross San Francisco Bay in Sheldon's "Water Walker." The "Walker" is Built of Sheet Metal and Consists of Two Pontoons Sliding in a Frame Work. Hinged Metal Fins Fold Back and Slip Thru the Water as the Walker's Foot Pushes the Pontoon Ahead.

One of the Smallest Motor Scooters, Known as the Golem, Recently Seen on the Streets of Berlin. The Europeans are Far Ahead of Us in Evolving Low Priced Passenger-Carrying Motor Vehicles. American Engineers are Watching Them With Interest.



The Post Hole Boring Apparatus Shown Herewith Takes the Place of Twenty Men. It Consists of a Huge Earthboring Auger on the End of a Twelve-Foot Geared Shaft Mounted on the Front of the Chassis of an Auto Truck.

An Interesting German Aerodynamical Testing Plant. The Thrust of the Airplane Propeller May be Accurately Measured by Noting the Velocity With Which the Truck is Propelled.

Auto Thieves Beware! This Auto Safety Alarm Consists of a Diamond Disc Holder on the Mud Guard of the Car, Which Puts the Engine Entirely Out of Commission. To Get the Machine Started Again a Round Disc is Placed in the Machine Upon the Removal of the Diamond Disc.
© Keystone.

Electricity Shines Shoes. Here's the New Way, as "Air-Felt" Electric Shoe Polishing Machine Exhibited at the New York Electrical Show. It Is Claimed the New Machine Does Not Hurt the Clients' Feet, Polishing a Pair of Boots in Two Minutes, With Less Paste Than Ordinary.

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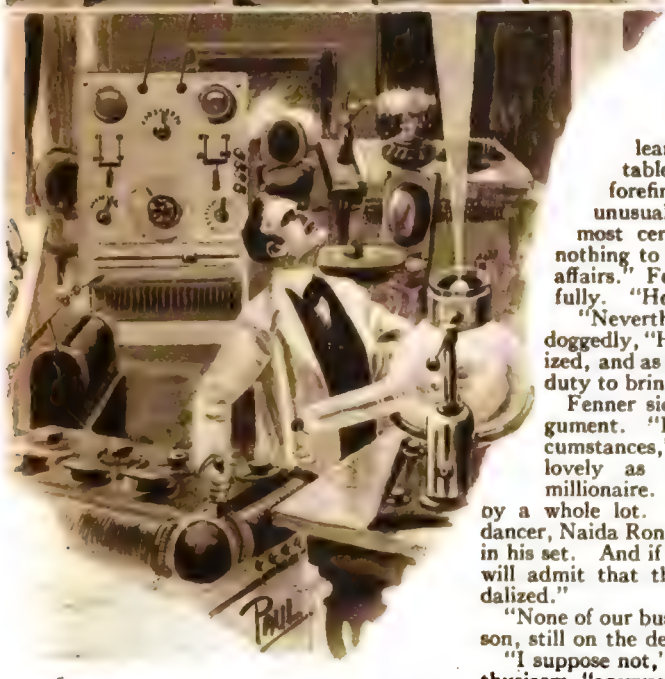
Without Residue

By CHARLES S. WOLFE

". . . Livingston, Unheeding, Continued. 'Just That, My Friend, Disintegration. It Would Fly Apart. While Passing a Cathode Ray Thru an Arc One Day, and Incidentally Thru Several Other Things Which I Choose to Keep to Myself, I Found That the Resulting Ray Produced a Current Which Just Nullified the Charges on the Atoms of Paper. Incidentally, I've Never Been Able to Strike the Right Combination for Any Other Substance. Now You See the Length and Breadth of the Affair. I Hired the Apartment Under Grory's, Set up My Stuff, Shot My Ray into His Safe, for Metal Doesn't Influence it, and . . .' "



DAVIDSON stared questioningly at Fenner. Smiling quizzically, Joe lit a cigarette with great deliberation—he was expert in the art of irritating the Chief—and leaned back comfortably in his chair. "Let's begin at the beginning," he said, calmly.

The Chief of Police vented his disgust in a half muffled snort, and surrendered. "Oh, all right," in resigned helplessness, "by all means let's start from there."

Thru half closed eyes Joe watched a smoke ring idling aloft. "It's been sixteen weeks since you sent me to Grory," he began, slowly.

"I know it," said Davidson, heavily. With difficulty I suppress a grin. The Chief wanted all his cases settled within twenty-four hours, and I realized that those sixteen weeks were as a rankling thorn in his flesh.

"Were it not," Fenner leaned forward to tap the table top with an emphatic forefinger, "Were it not for the unusual features of the case, I most certainly would have had nothing to do with Grory and his affairs." Fenner's lip curled scornfully. "He is simply despicable."

"Nevertheless," Davidson replied, doggedly, "His safe had been burglarized, and as officers of the law it is our duty to bring the burglars to book."

Fenner side-stept the proffered argument. "I'll review briefly the circumstances," he said, wearily, "unlovely as they are. Grory is a millionaire. More dollars than sense by a whole lot. His infatuation for the dancer, Naida Roner, was, I learn, a scandal in his set. And if you know that gang you will admit that they are not easily scandalized."

"None of our business," mumbled Davidson, still on the defensive.

"I suppose not," agreed Joe, without enthusiasm, "anyway, finally, they announced their engagment. With the wedding date set, and preparations for the event well under way, Naida experienced a change of heart."

"Because she met another man," murmured Davidson, sarcastically.

"Quite so," said Fenner, without emotion, "It is none of our business."

The Chief glowered suspiciously at the mask-like face, but contented himself with an ominous rumble.

"Anyway," continued the other, "she terminated her engagement to Grory abruptly. She threw a monkey wrench into the nuptial machinery. She rendered the rupture quite final by the simple expedient of marrying another man."

"Ancient history," commented Davidson.

"Necessary retrospection," countered Fenner, "Grory was furious. He felt the sting of ridicule. To him, egotistical ass that he is, his discomfiture was nothing short of a catastrophe. He planned revenge. And before Naida was returned from her brief honeymoon, he struck. He sued her for breach of promise."

"Seems to me," Davidson was elaborately judicious, "He had some grounds."

"We'll waive that," exclaimed Joe, impatiently, "He was a poor loser, that's all. The man Naida married was one of his own set, a chap with enough blue blood in his veins to establish a dye house, and not enough money in his pockets to buy a glass of near-beer. Grory realized that he was in no position to stand an expensive legal battle, and he took advantage of the pair's helplessness.

"Grory rested his suit on the evidence of a very foolish letter that Naida had written him during their mad escapade. It contained, he claims, an exprest promise of marriage and positive evidence of her intention to so marry. Having been outwitted by the little dancer once, he made up his mind that he would not be humiliated a second time. That letter was of prime importance in the prosecution of his suit. He took elaborate precautions to safe-guard it.

"In his apartments he had a fairly massive safe. He removed from it its contents, taking them to the safe-deposit vaults of a nearby bank. Enthroned in solitary state in that big steel box in Grory's apartment was the letter. He had the safe electrified. Not content with that, he hired a small army of guards, at least five of which were always on duty before the safe. In other words, he erected a sort of a shrine to the God of Revenge.

"It seemed impossible for any one to get to that safe and remove the letter. Yet, one night when Grory, returning from an orgy, went for a fond look at his treasure before retiring, it was gone!

"Gone, with five guards surrounding its receptacle, and electricity forming a silent but powerful sixth. I have often wondered why Grory didn't die of apoplexy on the spot.

(Continued on page 766)

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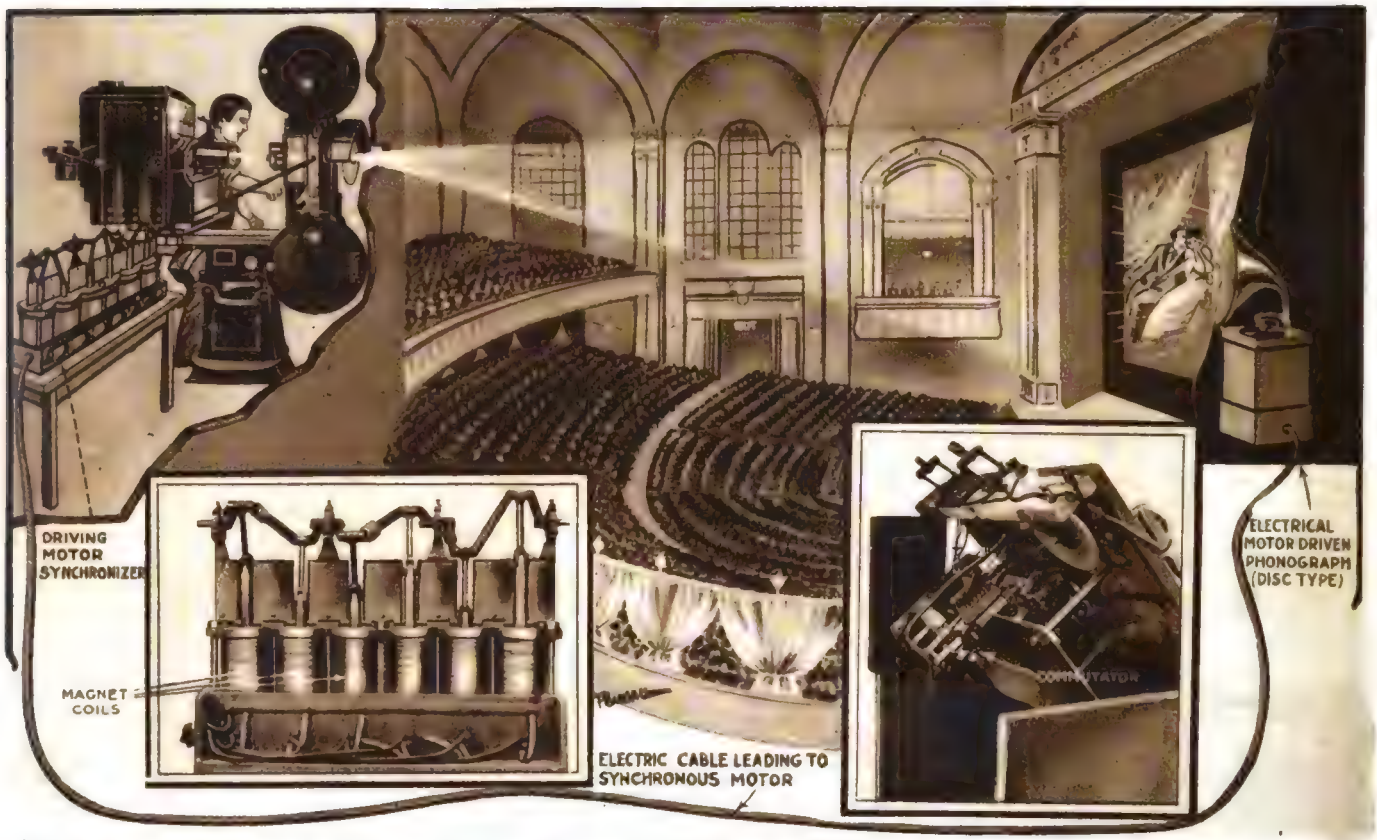
Perfectly Synchronized Talking Movies

By JOSEPH H. KRAUS



The Set-up as Employed in the Production of Talking Pictures in New York, in Which an Ordinary Phonograph, Electrically Driven, Was Used to Reproduce the Sound. To Produce a Sufficient Volume a Six Foot Horn Was Arranged in Back of the Moving Picture Screen. The Phonograph Opened Up Is Shown in the Insert at the Right. The Commutator Can be Clearly Seen. This Commutator Controls the Magnet Coils of the Solenoid Motor, Shown at the Left, Which Connects by Means of a Shaft to the Regular Projector. The Projector Is Thus Driven in Perfect Synchronism With the Phonograph.

REDUCING talking motion pictures to a practical basis instead of mere theoretical designs and exhibitory performances has been the work of a Mr. Orlando E. Kellum, of New York. The inventor has gone so far with this contrivance as to give actual exhibitions in legitimate theaters in combination with regular moving pictures. They were recently exhibited in Town Hall, New York City. Anyone who has been fortunate enough to view any of the numerous performances which extended over a period of months, must admit that synchronism between the picture and the spoken voice was absolutely perfect. Some nineteen inventions on the "Talkies" are the work of this man and there are many more coming.

The device which is shown in the photograph comprises a phonograph, to the turntable of which is secured a special form of electric commutator or circuit opener and closer. This commutator has six segments and two brushes mounted upon it. Leads from each segment of the commutator pass to the synchronizer, which is, rigidly mounted upon the main shaft of a motion picture projector. This synchronizer is in the form of a solenoid (electro-magnet) motor, each solenoid being energized intermittently and progressively so that two of them are under constant energization nearly all the time. In other words, before the current is completely shut off from solenoid No. 1, solenoid No. 2 has begun its power stroke. It has been found necessary to use additional power for driving the projector, since films have been speeded up in the last few years. This is accomplished by an ordinary rotary motor working in conjunction with the synchronizing motor and controlled by it, in that the rotary motor cannot travel above the speed set by the reciprocating motor.

A certain precaution is taken in the handling of this talking motion picture device. In starting the machine, the needle of a phonographic tone arm is placed in a transverse groove which is incidentally quite deep, at the edge of the record. This groove communicates with a spiral, considerably wider for the first turn and a half than the other spirals upon the record. The tone arm then connects to a large amplifying horn, which is 6 ft. in diameter and made of paper maché. In the throat of the tone arm an automatic damping arrangement may be found. This is for the purpose of allowing the phonograph turn-table to speed up to the required number of revolutions and also of allowing the projector to flash the subtitle of the photo-play upon the screen. When it is time for sound reproductions to begin, this damper is automatically opened and immediately the sound is heard by the audience. Such a construction enables the orchestra to play a few tunes without interfering with their chords, because of the slight scratching always found on records, which would in any other case cause quite a din. Another point of interest is that by employing a player-piano roll-cutting device and taking a synchronous picture at the same time, an exact reproduction of the artist's technique can be obtained and reproduced, with player-piano, or organ in unison with the film. By a similar procedure music suitable for the different scenes of a photo-play may be furnished.

Should the film become accidentally torn during its projection, a means is provided for again synchronizing the voice with the film, without the necessity of repeating the entire record. Several phonographs may be employed and it is rather interesting to note that one talking machine may be thrown out of operation, while the other one will continue exactly in accord with the first one. This advantage is possible because of the sound cut-outs in the throat of the horns, which permit the starting of a second motor at a certain predetermined time. The voice from this machine is then gradually superimposed upon the voice of the first talking machine, which has been operating up to the present time, and as the throat opening in one is made smaller, that in the other is gradually opened, and the result is that we are playing upon the second record while the audience does not know it.

When it is desired to show a talking picture, the operator on the stage merely changes the record and starts the talking machines, when he receives a signal from the operator stationed in the booth or projector room. Of course the film must also be put in a predetermined position before any of the operations are permitted to run.

Should any of the film be burned out or spoiled, that portion must be replaced with a piece taken from a duplicate film, or if that space be but a few frames they are replaced by blank film. A novel effect was exhibited to the writer. If a crank were placed upon the mechanism of the projector and an attempt were made to force the projector into a more rapid movement than its control by the synchronizer allowed for, the pressure exerted upon the crank was counteracted by a backward movement on the part of the synchronizer, which seems to have much the same effect upon the machine as the resistance of an active gyroscope. If one should on the other hand try to slow down the machine, he again meets with the opposite resisting force.

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The Glass City of To-morrow

By WILLIAM WALSH

ARTIFICIAL heat and light have made possible the modern city. Without them, civilization would be forced to return to the tropics whence it came. They are the indispensable allies that man uses in his upward march. We have, however, by no means conquered completely such adverse elements as the heavy snows and piercing cold of winter. But science now proposes to bring about a change as effective as tho we had bottled Italy's liquid sunshine, or Southern California's balmy breath. As a consequence, the city of to-morrow will bear little more resemblance to our present centers of population than a Zulu kraall now does to the present New York, Paris, or London.

The coming city will be of glass—a vast hemisphere rising from plain or valley as if to challenge Nature in her work of creating hills and mountains. Yet this great dome will be simply constructed, assembled on precisely the same principles that the Eskimo employs when, in constructing his igloo, he lays one block of ice upon the other, till his simple but admirably devised habitation is complete. To rear his metropolis, civilized man will use blocks of transparent glass, ascending tier by tier, and cemented together.

Strong columns of solid glass will serve for supporting pillars. Except for a great door here and there and removable sections to aid in ventilation, the vast structure will be as tightly closed as the old-fashioned beehive of twisted straw. Thru the transparent crystal the light and warmth of the sun and the beauty of the moon will find ready admittance, but the icy blasts from the north will be defied.

There will be no steel frames or trusses, no iron or marble pillars—no shadows, therefore, will fall by reason of the admission of outside light. Dust and moisture will be excluded and to a solitary individual standing beneath the center of the dome, the silence would be as profound as that of the ocean depths where the Titanic sank.

But this will be no city of solitude—no abode of a single inhabitant—for it will be filled with happy, carefree men, women and children, and humanity will here engage in its wonted activities with unaccustomed zest.

Picture yourself arriving at the walls of this city some bleak morning in December. A blizzard is raging and you draw your overcoat more closely about your shivering body as you step from the train. Passing thru a series of heavy glass doors, your nostrils are greeted by the warm scent of the tropics, the odor of flowers, and the song of troupes of birds is heard everywhere in the exotic foliage. You note with some surprise that tho the skies outside were heavy with snow, here the warm rich glow of sunshine seems to be everywhere diffused.

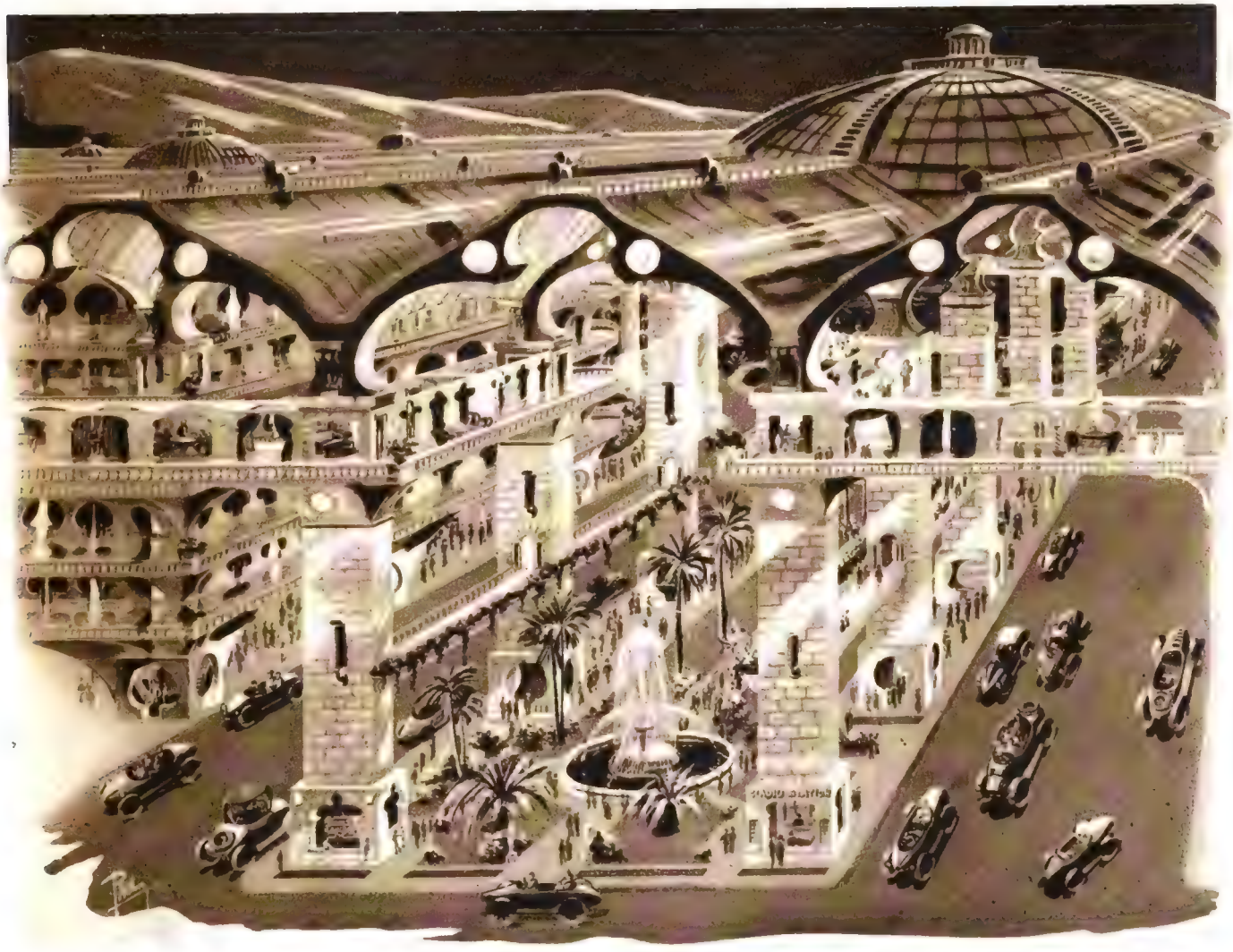
Then you enter dressing rooms provided for visitors to this crystal city, and having donned a Palm Beach suit, you set forth on your sight-seeing trip in an electric cab—gasoline automobiles are not permitted on account of their noise and their atmosphere-defiling exhaust gases.

You cannot shake off the impression that you have been transported to some magic city of the Arabian Nights. The dwellings are Oriental in architecture. They, too, are built of blocks of glass, with balconies partly concealed with vines and shrubbery.

Heavy curtains and hangings within are partly drawn, to exclude the gaze of the curious. Presently also you discover that the roofs themselves are as transparent as air and that blinds under the roofs shut out the rays of the sun as required.

Roads and paths curve everywhere thru

(*Continued on page* 785)



The Glass Domed City of To-morrow Will be Like a Veritable Paradise. Yourself Enjoying a Climate Like That of Florida or California. The City W the Streets Like Sunshine Even on the Darkest Day. Th[illegible] Will be Mounted on the Columns. The Glass Ro[illegible]

Blizzard May Rage Outside, but Once You are Inside the Glass City, You Will Find a Heated by a Central Heating Plant, While Powerful Electric Lights Will Illuminate in Perfect Condition as Well as the Humidity, by Electric Ozonators and Purifiers ade of Blocks of Solid Glass, no Metal Frame Being Used.

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Crops Grow on Moon

THE unwarranted assumption that the moon is dead and that nothing can live on its surface has caused astronomers to fail to study it, according to Professor William H. Pickering, of Harvard, one of the greatest living astronomers, who in a report on two years' observation of the moon asserts that the existence of life is more easily traceable on the moon than on Mars.

Crops grow on some parts of the moon at the rate of two a day, the day on the moon being as long as two of our weeks. They are believed to grow only in the craters, with which the face of the moon is extensively pitted and which are believed to contain water and possibly a supply of heat. Professor Pickering has discovered steam issuing from some of the supposedly dead craters. The assumption has been that, because the moon had no atmosphere and because its temperature was presumably hundreds of degrees below zero, no life could exist there.

Professor Pickering, who has made a life study of the moon and of lunar conditions, severely criticizes astronomers in general, because they have paid so little attention to it. Everybody had an idea that the moon was dead and therefore paid no attention to a world that is, perhaps, alive with creatures, maybe intelligent, and maybe not, right at our very door.

Few astronomers examined the moon, except on the terminator itself. This is because the latter is more beautiful than the other regions which are neglected because of this fact, in spite of their interest.

The "terminator," or boundary line between light and darkness, which would correspond with that part of the earth where the day was breaking, is the more interesting because the light and shadow effect shows the moon's features in relief, enabling the astronomer to make out clearly its extremely rugged and mountainous surface.

Fifty-six hours of sunlight in the crater of Erastosthenes II, which Dr. Pickering made a particular object of study, evoked plant life. Nothing in Dr. Pickering's report indicated that these were cultivated crops. After describing the appearance of dark patches, which sprung into existence and then faded out, he continued:

"Expressing the matter otherwise, we may say that the vegetation requires two and a half days to appear, it lasts for only two days, and then rests for three days, and then produces the second crop, lasting for four days more, which then gradually disappears in the evening shades. We thus have evidence of a variety of lunar vegetation. The wings of the northern spot begin to develop as soon as the sunlight strikes them."

These periods vary, however, in different fields of vegetation observed. Crops with different exposures vary in duration from two to eleven days, and the average is about a week.

"In quickness of development," says Professor Pickering, "some of it even vies with our mushrooms and toadstools. The crop has to be brief in order to ripen at all, and it is doubtful if any of it in the region we have described lasts through the lunar night."

Telling how dark patches and lines varied in their positions he continued:

"It thus appears that the runs on the moon, like the canals on Mars, shift their positions over the surface. In both cases the surface discoloration has changed its place. This cannot be due to mineral or inorganic forces. Life, therefore, exists on both these planets."

"Indeed," he continued later, "instead of finding the moon a dead, unchangeable body, as it is usually regarded, we find that the shifts and changes taking place in certain of the lunar detail, after all the shadows have disappeared, present the chief difficulty to the selenographer (geography of the moon) who endeavors to sketch these features with accuracy."

After describing how fields of vegetation darken, spread, grow pale and shrink, Dr. Pickering continued:

A Few January Articles

The Man in the Moon—A Cave Man. By C. S. Corrigan, C. E.

Engineering for My Boy—How and Why of the Engineer's Profession. By H. Winfield Secor.

Baseball Movies by Wire—An Electrical Score Board that Shows Football and Baseball "Plays."

The Motorless Airplane; Is the Glider to Supplant the Motor-Driven Craft? By Stanley Yale Beach, Ph. B.

Quartz—Its Relation to Man and its Place in Nature. By Dr. Ernest Bade.

Why Our Winters are Warmer. By Isabel M. Lewis, M. A., of the U. S. Naval Observatory.

Buying a Second-Hand Car. By Edna Purdy.

How Plate Glass is Made. By Robert G. Skerrett.

How to Make a Microphotographic Camera, and Use it. Written by an Expert in Microphotography.

Fortunes from Flashlights—How a Simple Idea Made Millions of Dollars. By Charles Frederick Carter.

Ultra High Speed Atoms—And their Effects. By Rogers D. Rusk, M. A.

Scientific Fiction—The Best Stories Based on the Possibilities of Science, that You ever Read.

"This description typifies the changes constantly occuring in many well-defined lunar fields in the course of their development, changes much more marked than any occurring on Mars."

Discussing one area of apparent vegetation, which he calls the Southeastern Field, Professor Pickering continues:

"We now come to one of the most interesting of all the fields of this crater, because its changes are not only very marked, but also because they occur chiefly near the time of the full moon, so that they can be studied for several hours continuously."

After describing how the vegetation varies with different amounts of sunlight the astronomer says that the field finally acquires the pattern of a "lobster or a crab, with sharply curved claws."

"Another curved canal," he continues, "is now formed on the northern side behind the front one, owing to the interior fading of the field. The advance of the dark head of the man now progresses slowly down the crater's inner wall or floor."

Dr. Pickering told of snow storms or snow "eruptions" on the moon and of discovering clouds within large craters, whose circular movements puzzled him.

"Just why the snow should shift and revolve within the crater," he said, "is as much a mystery as why the clouds within many of the crater rims should brighten successively clockwise in the northern hemisphere and counter-clockwise in the southern. It is to be remarked that, although Erastosthenes II is in the northern hemisphere, the rotation of the snow is counter-clockwise or opposed to that required by the law for the clouds. The successive brightening of the clouds can be watched by any one and is much easier to observe than the change of the position of the snow."

The moon has been considered to lack atmosphere because it presents a clean edge in eclipses, when sunlight is not disturbed or changed in passing it, as it would be if the moon had a perceptible atmosphere. It has been recently calculated by American astronomers that the moon's atmosphere must be less dense than one part in 1,750, as compared with that of the earth.

In substance, the moon is considered to be about identical with the earth, because it is usually held that the moon was once part of the earth, breaking away from it hundreds of millions or billions of years ago. The moon is supposed to have no atmosphere because it is not big enough to have a force of gravity sufficient to attach an atmosphere to itself. For instance, the earth's mass gives it a force sufficient to hold anything moving at a speed under six and nine-tenths miles a second.

The molecules of free hydrogen and helium are believed to attain a speed in excess of six and nine-tenths miles a second, thus overcoming the force of gravity and eventually escaping from the earth's atmosphere. Oxygen molecules move less rapidly, and combined oxygen and hydrogen molecules less rapidly, than six and nine-tenths miles, so that they are retained in the atmospheric envelope of the earth. On the other hand, the moon has not mass enough, according to theory, to hold the gases which form our air.

Mars has barely enough mass to control the velocity of molecules of the air, but still has a very thin atmosphere, which has always been put forward, as in the case of the moon, as the strongest evidence against the existence of life.

In reply to this, the astronomer Flammarion has said that a fish would argue that no life could exist on earth because of the lack of density in the air. To argue on this ground, he said, that life could not exist on Mars was to argue like a fish, not like a philosopher.

In our accompanying illustration, we have tried to show graphically, what Professor Pickering claims to have seen. The scene is laid in one of the craters of the moon, exposed to the full sun-light at the height of the lunar day. Here we see tremendously high mushroom growth several hundred feet high. Due to the low gravitation on the moon—a 200 pound man on earth weighs only 51 pounds on the

(*Continued on page* 753)

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Learn and Work While You Sleep

By H. GERNSBACK

Member American Physical Society

COMING INVENTIONS

THE normal human life covers a period of some seventy years. During this time, the average adult sleeps eight hours a day, or roughly speaking, one-third of the time. Thus, the individual when he reaches seventy years of age may be said to have lived only about forty-five years. The other twenty-five years have been taken up in sleep.

While the average length of sleep is about eight hours, it must be taken into consideration, that up to the tenth year, the human body requires more than eight hours of sleep daily, and there are many days during the year, such as holidays, when we sleep considerably more than eight hours. This brings the average up to somewhere near our figures. In other words, over one-third of our lives, may be said to be wasted by unproductive sleep. During this time, we are truly dead in the best sense of the word, because sleep is only another form of death.

During our sleeping periods all our usual functions are suspended; of our five senses none remain conscious. We hear no longer; we feel no longer; we see no longer; we smell no longer; we taste no longer. This statement may be qualified at once, by saying that all of the five senses have ceased operating *only* if conditions are right, or rather normal. To elucidate, a man may be sleeping soundly near a busy railroad, where trains crash along every few minutes, and he will not wake up. *He has become accustomed to the disturbance.* But let a rat or mouse start nibbling in a corner of his room, and he will wake up almost immediately. Why is this so? The reason is that the human body while asleep, is only dead to the accustomed things, and the instant something *unusual* occurs, the sentinels of the particular sense affected immediately send out its warning.

Thus, while we do not hear the ponderous trains crashing by, the unaccustomed noise of the nibbling mouse awakens us, because it was not foreseen by the sleeper. *Our subconscious self never sleeps.* It is always on the alert. All of the other senses act in the same way, as just exemplified with the sense of hearing.

Thus we sleep along peacefully, but an acrid odor, which is not foreseen, will awaken us. We may turn around and toss about in bed and have every part of our body come in contact with the linen of the bed. It will not awaken us, but a single drop of cold water falling on our hand, will instantly rouse us. Why? Because it was not expected by the sleeper. The same is the case with taste. A man may be snoring along peacefully with his mouth wide open, but if you allow a few drops of sugar-water, or any other unusual solution to fall upon his tongue, he will awaken in nearly every case.

You might think that, when closing your eyes during the night, light would not affect the retina. This is far from true. Try the experiment of switching on an electric light close to a sleeper's face. He will awake almost instantly. Why? Because the lids are translucent, and allow light to pass quite easily. The moment an unaccustomed strong light falls upon the eye lid, we awake.

Why do we not then awaken in the morning when the sun light falls into the room? Very simply because we have grown accustomed by many years of experience to this daily procedure, so it no longer disturbs us. It is the accustomed thing, that fails to disturb the subconscious self, but the unusual affects it strongly.

The writer found it necessary to digress from the real purpose of this article, simply to show how the human body acts under various stimuli.

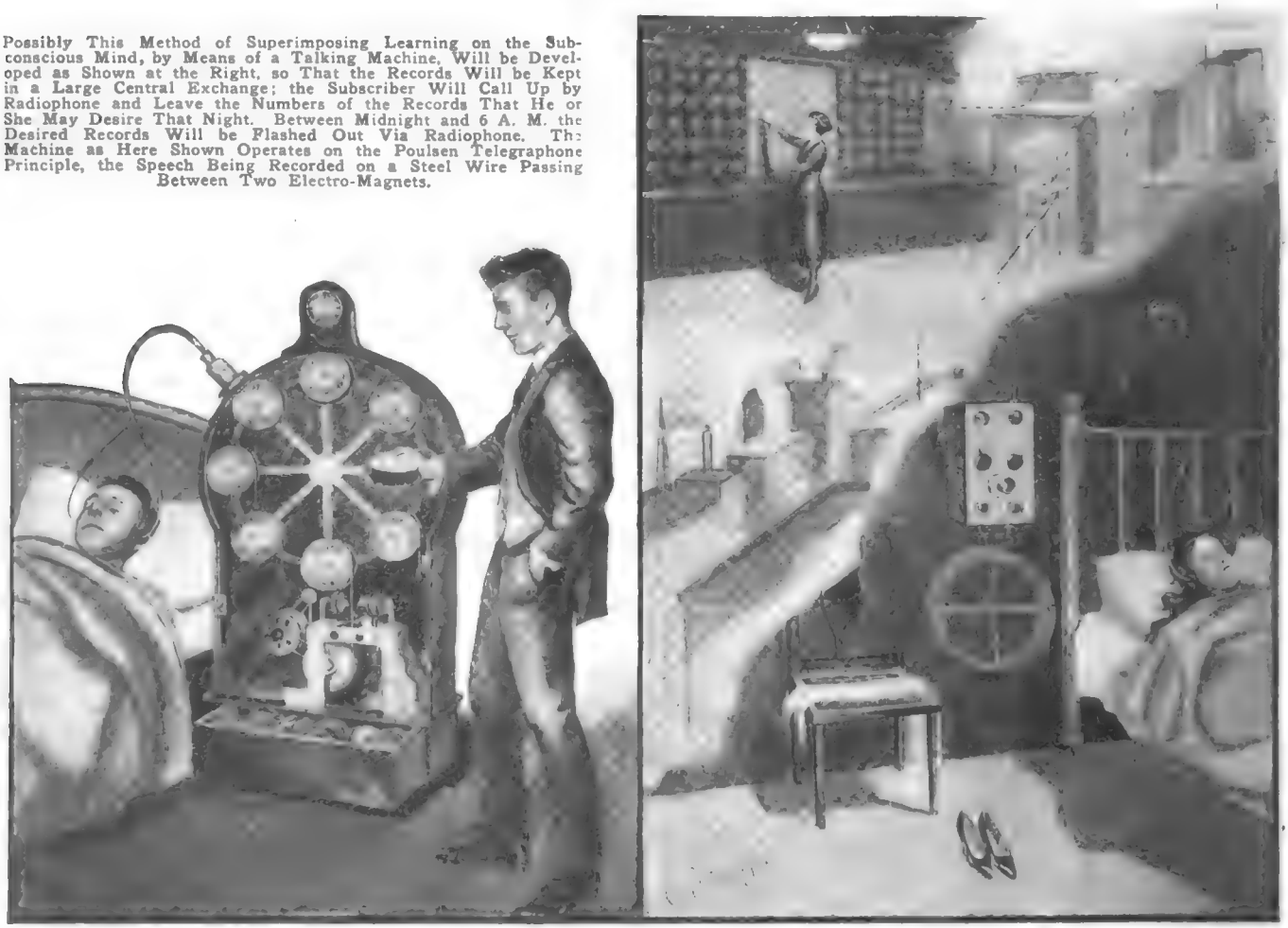
Suppose we could find a way in which we could act upon our sleeping senses in the night time! We would immediately have lifted up the entire human race to a truly unimaginable extent.

Suppose it was possible for you to read, learn, or work while you sleep. Would we not thereby extend the period of our lives by one third?

Suppose it was possible to devise an apparatus whereby you could read a book, or study a language while you slept. Would it not be an inestimable boon to humanity? We may be sure that in years to come, we will have arrived at just such a point. There is nothing impossible in science, and our problem is greatly simplified by the fact that when the

(*Continued on page* 752)

Possibly This Method of Superimposing Learning on the Subconscious Mind, by Means of a Talking Machine, Will be Developed as Shown at the Right, so That the Records Will be Kept in a Large Central Exchange; the Subscriber Will Call Up by Radiophone and Leave the Numbers of the Records That He or She May Desire That Night. Between Midnight and 6 A. M. the Desired Records Will be Flashed Out Via Radiophone. The Machine as Here Shown Operates on the Poulsen Telegraphone Principle, the Speech Being Recorded on a Steel Wire Passing Between Two Electro-Magnets.



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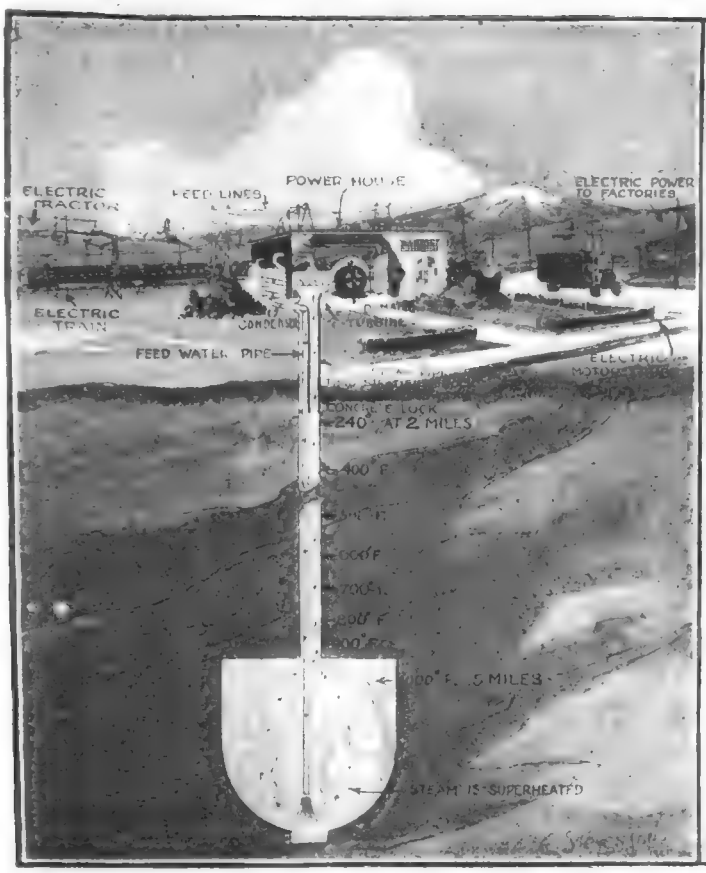

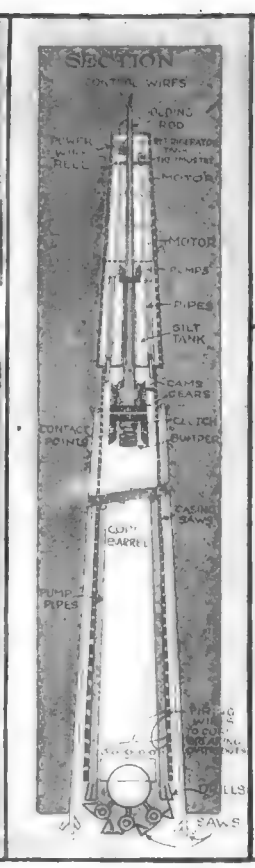

This new Chain Saw Was Developed to Cut Thru Coal, and When Properly Modified, Mr. Corrigan Expects to Cut Deep Shafts Into the Earth Very Rapidly, and at a Lower Cost than Heretofore.

Mr. Corrigan, the Author of the Present Article, Has Invented After Many Years of Research, the Remarkable Chain Saw Shown in the Accompanying Illustrations, by Which Means He Has Made It an Economical and Feasible Proposition to Cut Deep Shafts Down into the Earth, so as to Utilize the Interior Heat of the Earth. By Sinking a Shaft to a Level of 5 Miles a Temperature of 1000° F. Is Reached. If Water Is Discharged into the Underground Steam Chamber as Shown, Superheated Steam Will Form and Rising, Will Operate a Steam Turbine Driving a Dynamo, etc. The Center and Right Hand Diagrams Show the Electric Motor-driven Deep Well Saw, and the Method of Sawing Horizontally to Form Steam Chamber.

Electric Power from Earth's Heat

By C. S. CORRIGAN, C.E.

FROM tests carried out in deep mine-shafts in different parts of the world, science knows today that the temperature of the earth increases a certain amount for every 100 ft. we descend in such shafts. By means of a new earth and rock saw illustrated in the accompanying pictures, it is proposed to cut a shaft down to at least a 5 mile depth, at which level it has been computed that a temperature of 1,000° Fahrenheit will be reached. The operation of the electric generating system for utilizing the interior heat of the earth is shown in the sectional view of the power house and shaft. Water is fed downward thru a pipe, and when this reaches the lower part of the well or shaft, it is converted into superheated steam, owing to the very high temperature present; the steam ascends thru the larger pipe and serves to operate a steam turbine. The steam as it passes out of the turbine thru the exhaust pipe passes into a condenser of the usual type, which converts it back into water once more, the water passing down the pipe to the bottom of the shaft again. Thus the process repeats itself over and over, a fresh amount of water being added from time to time as required. The steam turbine, or turbines, drives an alternating current generator, the voltage of which is raised by step-up transformers to several hundred thousand volts so that it can be transmitted over wires for distances of 300 to 500 miles, in the distribution of electric energy for light and power. Possibly by the time this power plant scheme has been put to practical use to a very large extent, the new 1,000,000 volt General Electric Company scheme of electric power transmission and distribution will have been developed thoroly, so that electric power can be transmitted over an area extending 1,000 miles from the power plant in every direction.

To cut into the earth quickly and economically has been man's object for ages. To drill and blast has been the usual method but it is dangerous; to eliminate blasting various stone-cutting chain saws have been invented; to make the cut as narrow as possible, raised portions of the links of the chain were shaped as teeth, but these teeth wore out so quickly and entirely new chains were required so often, that they have not proved economical. Circular saws with inserted carborundum teeth are used economically in open stone quarries, but on account of their shape cannot be used underground. So called chain saws (heavy link chains with renewable picks inserted for teeth) have been developed for economically undercutting coal, but do not operate satisfactorily in stone. To undercut 5" wide the chains are run about 700 ft. per minute and have picks in the same position every 3½ ft. so 200 picks pass the same point each minute, and each pick must dig ⅛" deep continuously for the saw to advance 2 ft. per minute which is the average.

The new chain saw devised by the writer and shown in the photograph, was developed to make narrow cuts in coal so that it could be sawed loose on all sides and removed from the mine with the expenditure of no more time, power or waste of coal than now used in undercutting. It runs about 2,000 ft. per minute, has a set of 3 teeth every 2", so 1,200 teeth pass the same point each minute, and if each scratches 1/100" deep, the saw will advance 10 ft. a minute.

When renewable carborundum teeth are used, this chain saw will cut stone, reinforced concrete, etc. It can do all kinds of underground tunnel, shaft and mining work without the use of explosives; its work can be continuous; there is no delay on account of powder fumes or shoveling loose material; 3 shifts could be employed and more progress made in 24 hours than is now made in a month. All material being taken out without disturbing the material left, fewer props would be required, tunnels, shafts, etc., could be cut the exact size for concrete or steel lining.

Realizing the improbability of ever sinking mine shafts or large wells down to intense heat with the apparatus of the present day, I began considering other methods. Stone cutting circular saws making narrow slits, are used to a large extent in stone quarries. In coal mines coal-picking chain-saws, cutting wide slits, are used like knives for undercutting the coal; it occurred to me to combine the two ideas, so I made the stone cutting chain-saw shown, that cuts a narrow slit, and when operating can be pushed into the earth like a knife. On trial it proved very efficient; I then designed a core-sawing deep-well machine using four such saws about fifty feet long, directly connected to an electric motor and so arranged that the entire machine can be lowered into a well and operated and controlled by electric power transmitted thru the sustaining cable. Cartridges are provided for breaking the core loose and core lifters for

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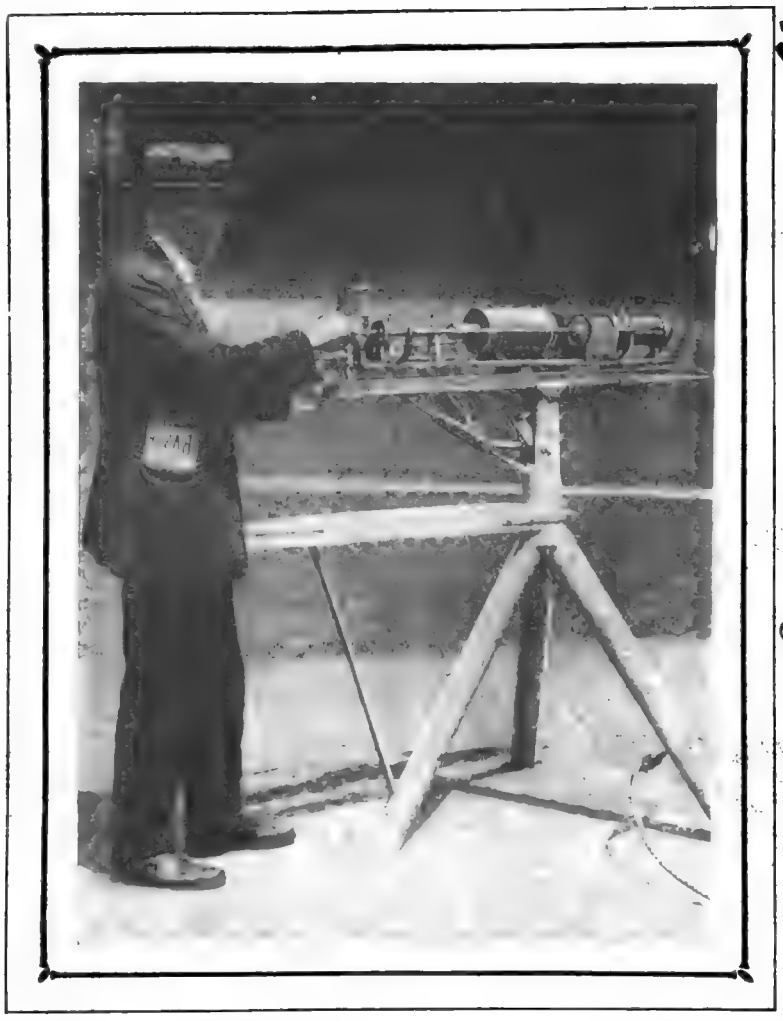

The Photographs at the Left and in Lower Right-hand Corner Show a New Electrically Operated Automatic Baseball "Pitcher." It is Said to be the First Successful Machine Which Will Actually Throw Any Degree of Curve or Drop Ball. It is Expected to be a Great Aid for Batting Practise.

The Upper Right-hand Photo Shows a Most Ingenious Invention—Field Glasses for Viewing Baseball or Football Games, which are Held in Front of the Eyes, the Same as a Pair of Spectacles. Funny, Isn't It, That Someone Did Not Think of This Simple and Highly Desirable Form of Miniature Field Glass Years Ago?

Electrical "Pitcher" for Baseball

IN the accompanying illustration we see Benjamin Blair and the automatic electrically operated pitcher, that he has invented. The machine has an assortment of curves, breaks, and drops, and a beautiful *change of pace* and for batting practise cannot be beaten. Unfortunately, it cannot field and so is not practicable for regular championship playing. The picture shown herewith was taken while Mr. Blair was demonstrating his machine to the "White Sox" and "Yankees" at the Polo Grounds, N. Y.

Mr. Blair is to be congratulated on perfecting a pitching machine which would be amenable to rapid adjustment, so as to throw fancy curves and drops at will, in order to provide the proper practise for the big league teams. Several pitching machines have been devised in the past, but for some reason or other they did not apparently seem to deliver the goods.

Also we have here the latest idea in field glasses, designed for the convenience of those who follow baseball or the races. The lenses of these field glasses are adjusted to the eye the same way that the regular glasses are. The spectacle frame idea does away with holding the glass up until arm or hand are tired, and the glasses focus much better in this way, as they are held at a constant distance from the eyes at all times.

An Electrocuted Fish Hawk

The fish hawks of the New Jersey coast have acquired some celebrity. The interesting bird is protected by law, the regulations against killing them being a very stringent provision of the state game laws. The bird shown in the photo, by attempting to take possession of a pole on a high voltage transmission line, proved to be a suicide and his own executioner. The circuit is operated at 22,000 volts potential, and

The Laws of the State of New Jersey are Very Stringent as Regards the Protection of Its Famous Fish Hawks. These Interesting Birds have Nesting Privileges on the Coast Because They are Thus Protected, but This Poor Fellow was Electrocuted With No One to Blame but Himself. He Established a Short-Circuit Between Wires of the Power Line and Suffered a Loss of His Life in Consequence Thereof. He Measured Five Feet from Wing Tip to Wing Tip.

the bird caused a very vigorous short-circuit. The head and left wing were burned off. The wing spread of the bird was five feet, and it interrupted the service for several minutes, before the cause of the short circuit which it established was discovered. As the bird was killed, we cannot hope that he will have learned wisdom by experience. It is to be hoped that his companions will take warning.

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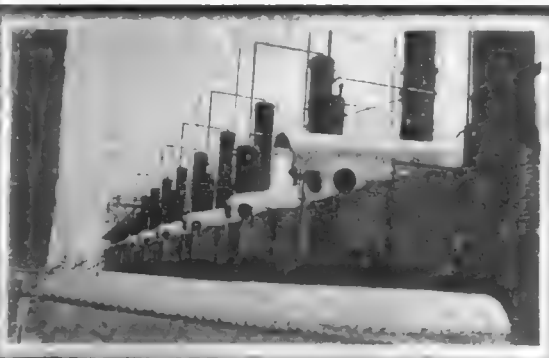
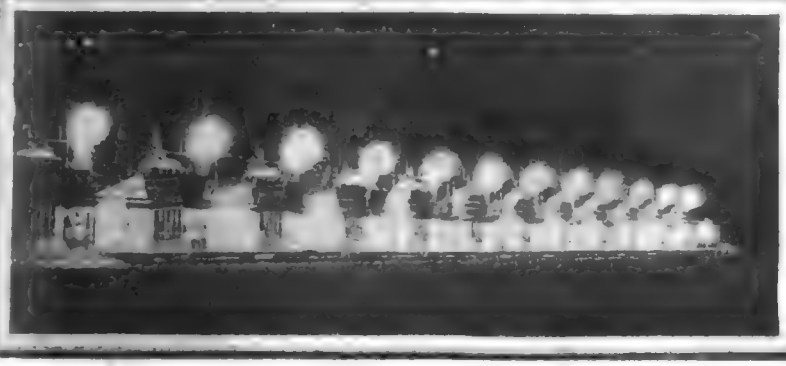
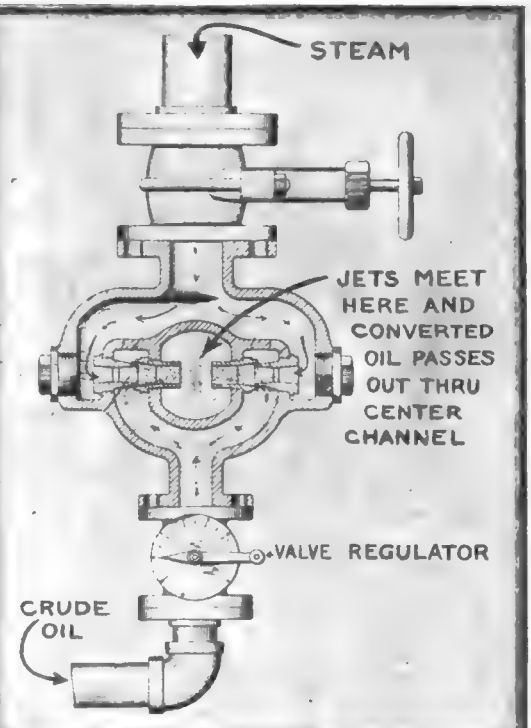
Impact Process of Making Gasoline

By D. C. MINER



Heretofore Less Than One-Third of the Total Bulk of Crude Oil has been Distilled off as Gasoline; and after Lubricants, Kerosense and Less Volatile By-Products are Collected, About One-Third Remains Suitable Only for Fuel. A Philadelphia Inventor has Devised a Process of Making Gasoline from This Waste Oil. He Derives 70 Gallons of Gasoline from 100 Gallons of Oil.





BY the present methods of the petroleum works less than one-third of the total bulk of crude oil is distilled off as gasoline; then, after lubricants, kerosene, and less volatile by-products are collected, about one-third remains, suitable only for fuel.

Mr. Victor Lee Emerson of Philadelphia has discovered, patented and marketed a new process for making gasoline from this waste oil; he can derive 70 gallons of pure water-white gasoline, 67 degrees Baumé in specific gravity, from 100 gallons. The efficiency of this gasoline surpasses the ordinary commercial grade now on the market in so great a degree that the company using the Emerson process is mixing it with the ordinary product to give the added *pep*.

The general adoption of this new process, which produces from 60 to 75 per cent. more gasoline than the present supply, means a possible increase in available gasoline to seven billion gallons. All this comes from tiny jets the size of a human hair, through which the fuel oil vapor is forced. The setting of these jets is most delicate, for the opposite jets must face each other; in other words, the minute opposite individual jets impinge directly one against the other. They are but an eighth of an inch apart and minute accuracy of adjustment is necessary.

(*Continued on page* 777)

Testing Gas Appliances and Auto Wheels

THE Bureau of Standards at Washington, D. C., has done some of the most accurate work in the realm of physical and chemical measurement that the world has ever seen, but one of its pecularities is that it does not confine itself to the pure theory of the scientists, but devotes, perhaps, most of its energy to solving the problems of everyday life; precisely the realm where such investigations are needed.

In one of our illustrations we give a view of the gas laboratory in which the scientists study the domestic uses of gas, and the home utensils are rigorously tested. The accuracy of the commercial gas meter, the quality of gas burners, the efficiency of gas stoves; all these subjects come within the ken of the gas laboratory.

In the background are seen two gas holders, that supply gas at any desired pressure. The observer is noting the volume of gas and rate of passage by a standard meter calibrated so as to give the volume of gas passing thru it with the greatest possible accuracy. Pressure gages are seen distributed about the room, and other apparatus as well.

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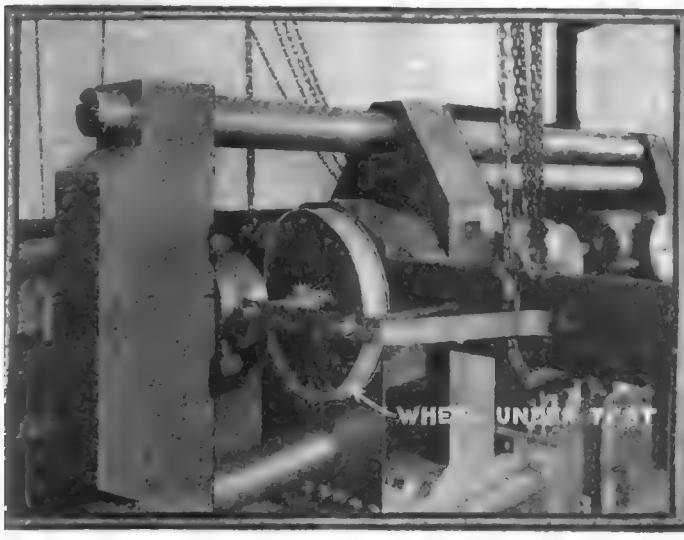

The Illustration Above Shows One of the Many Bureau of Standards Laboratories at Washington, D. C., Where an Airplane Landing Wheel Is Being Tested.

This Photo Shows Another Bureau of Standards Test Being Made on Gas Apparatus. These Tests Include Gas Meters, Burners, Stoves, Etc.

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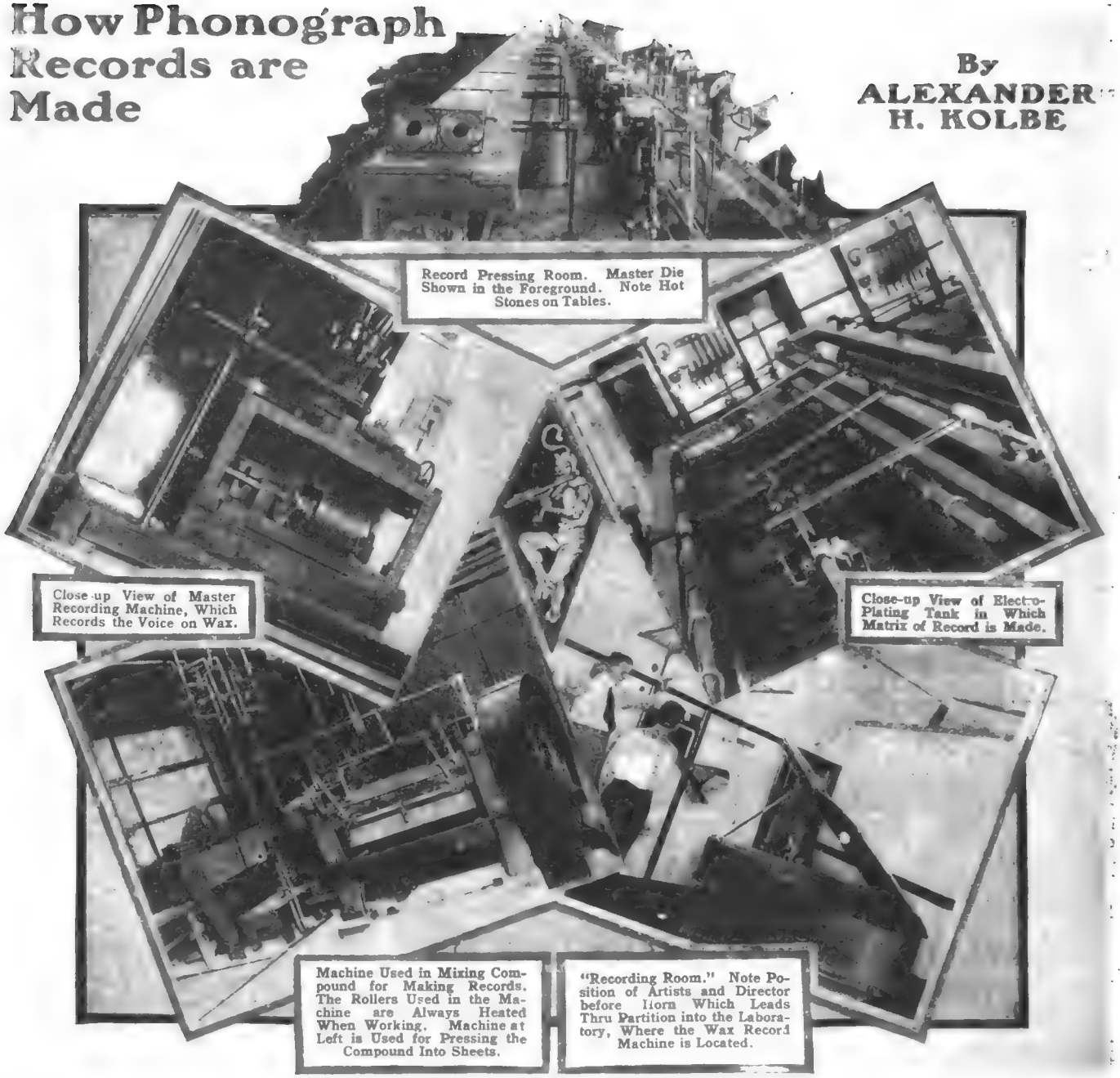
How Phonograph Records are Made

By ALEXANDER H. KOLBE



Record Pressing Room. Master Die Shown in the Foreground. Note Hot Stones on Tables.

Close-up View of Master Recording Machine, Which Records the Voice on Wax.

Close-up View of Electro-Plating Tank in Which Matrix of Record is Made.

Machine Used in Mixing Compound for Making Records. The Rollers Used in the Machine are Always Heated When Working. Machine at Left is Used for Pressing the Compound Into Sheets.

"Recording Room." Note Position of Artists and Director before Horn Which Leads Thru Partition into the Laboratory, Where the Wax Record Machine is Located.

PHONOGRAPH record making is an art, and it is with great care, difficulty and expense that they are produced by the American manufacturers. Thru the kind and able assistance of Mr. A. C. P. Russen, Newark, N. J., engineer and expert on machinery for making not only phonograph records, but music rolls, this article together with the accompanying illustrations was made possible.

Manufacturers of phonograph records absolutely refuse to disclose their secret of making such discs. For this reason alone, photographs have never before been published in this country in connection with an article such as this. The many excuses given out are that every maker of phonograph records, design their own machinery, lay out their own electrical apparatus and often use special mechanical and automatic machines of their own invention.

Talking to the "First" Record

The first step in the manufacture of a phonograph record is the making of original wax discs which are about one-half inch larger in diameter than the finished record to be produced and about three-quarters of an inch thick. These discs are formed by using a fairly soft composition of wax. The original wax discs are placed on the recording machine, which to all purposes is a phonograph except that it is more delicate in construction and that the action of the needle is reversed, that is, instead of the needle falling into a groove, it is forced by the transmitting diafram into the soft wax.

Let us now consider the making of this first impression. The recording room is so arranged that the best results will be obtained. The recording machine is placed in a separate room and only the receiving horns project into the recording room. Special attention is given to the seating arrangements in the recording room. Seats for the orchestra are arranged in a semi-circle. Each chair differs in height to suit the needs of the individual instruments to be played in order that the air vibrations will be most effective in registering thru the diafram on the recorder. In making vocal selections, special attention is given to the distance separating the singer and the machine.

How a Matrix Is Made

The most important factor in the making of records is the first soft wax record or master. The impressions on the wax are very delicate and therefore the record could not be used directly in producing other records. The next step in the manufacture of records is carried out in what we shall term the electrolytic department. The equipment in this department consists of large rectangular tubs lined with lead and filled with a solution the same as used for electrotyping. Suspended on two round brass rods running across these tubs are anodes, usually copper plates, with two wires hooked over the rods, making it possible for the entire plate to be submerged in the solution. Parallel with these bars and midway between is another round bar of the same size on which swivel-connections, evenly distanced apart, are located. Suspended vertically from each of these swivels is a small rod with a long end hanging into the solution below the swivel, and a short end above the solution and the swivel. At the ends of these rods in the solution are the wax discs. See diagram herewith.

The object of the above arrangement is to have the discs maintain a continuous pendulum motion in the solution. This motion is produced by a rod which continuously moves back and forth.

To explain how the small particles of copper are taken from copper plates or anodes and deposited on the wax discs would involve a scientific discussion of

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great length. It is sufficient to know that the action is due to the electric current plus the chemical action of the solution. The electric current, circulating thru the anode bar and anodes over and across to the wax discs hanging on the swivel arm, carries small particles of copper and deposits them on the wax discs with such close adhesion that they pile up in a mass over the face and grooves of the wax record.

Great care is exercised in keeping up an even, continuous flow of electric current. After an immersion of twenty-four hours the wax record is covered with a coating or sheet of copper. The copper sheet is stript off very carefully and the rough edges of the copper discs are trimmed off that portion which projects outside and beyond the diameter of the wax discs. This disc becomes the master matrix and from it reverse duplicates are produced. The copper impressions stand out on the master matrix where they are deprest in the wax record.

Making a Matrix from a Matrix

After coating the back and edges of the master matrix with wax so that the copper particles will cling only to the part not waxed, these impressions are suspended in the same manner as the original wax disc. After twenty-four hours the discs are stripped again, the same operations being carried out. The second copper disc is called the mother matrix, and by treating the mother matrix the same as the master matrix there is produced what is termed the pressing matrix. The latter is used to press records for the trade. The master matrix is carefully guarded by the producing concern. These steps are all shown in the accompanying diagram.

The product, after passing thru these stages of manufacture is ready for the pressroom. In this department there is a steam rolling mill consisting of two or three steam-heated rollers supported in proper frames and driven by gearing. On the top of this machine there is a hopper into which the composition entering into the finished product is placed. The materials used in the ordinary black record consist chiefly of shellac with portions of rotten stone and lampblack. These are carefully pulverized and screened free from metal or other foreign matter. The composition is placed in the hopper and heated and mixed by the rolls to a consistency a little stiffer than bread dough.

Great care is exercised to get a resultant mixture that will produce a hard, glossy record impervious to slight changes of temperature. A mixture too soft would tend to warp records.

The mixture is flattened out into strips by another set of heated rolls. Rectangular strips about five inches wide and 3-16 of an inch thick are cut and sent to the pressroom. These strips are placed between dies consisting of two square steel plates into the faces of which round depressions have been turned equal in depth to one-half of the thickness of the finished record plus the thickness of the copper matrix. A separate lipt ring holds the matrix by its outer edge face up, so that when this ring is screwed down the matrix becomes a part of the one-half mold.

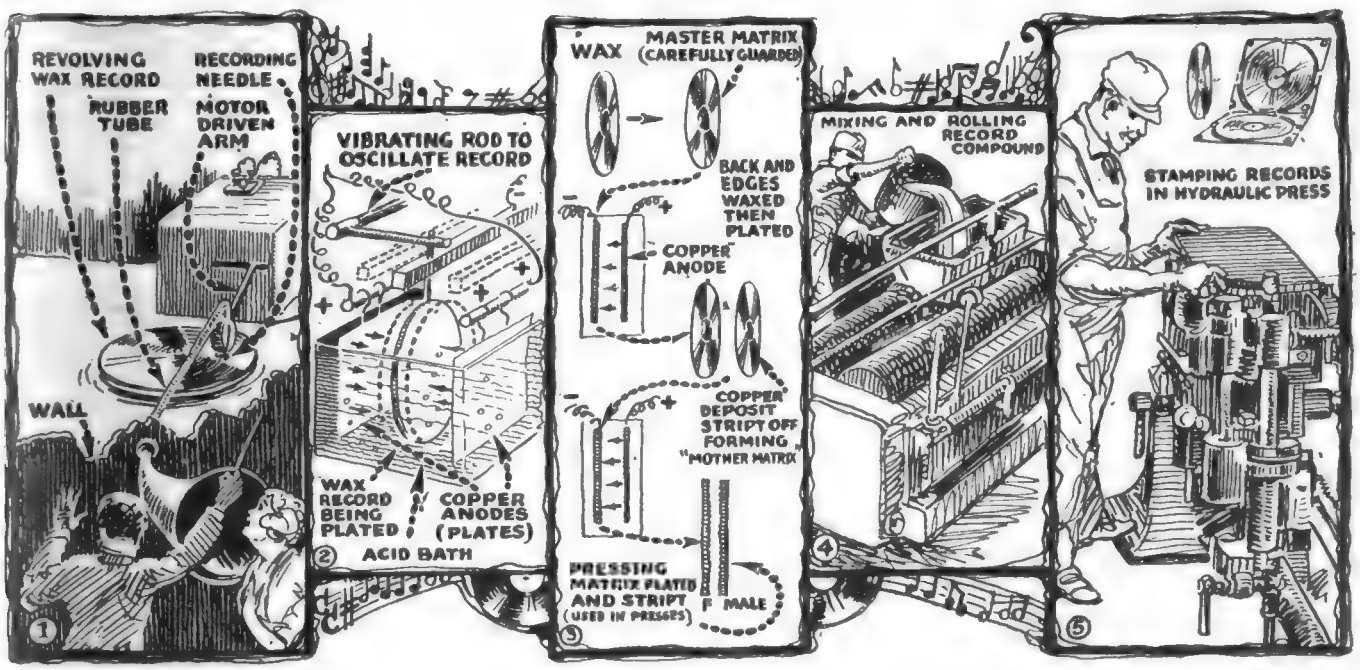
Records Are Stamped in Presses

The composition squares of shellac stock are cut into smaller squares. These pieces are laid on a warming plate until warm enough to proceed. Then the printed paper circle is placed over the central pin face down, and later face up, in the die against the matrix. A hole is then punched into the soft composition. Both halves are placed together and kept in position by the central pin and two dowels.

The complete die is placed in the hydraulic press, the dies being warm and the stock pliable. As the two half-dies are prest together, the lump of stock is flattened until it flows to fill the entire opening plus a little that overflows, the latter forming a slight fin around the outside edge of the record midway of its thickness.

The tables of the hydraulic presses are raised by water pressure coming from a small pump producing 500 pounds pressure to the square inch. Each record is therefore subjected to from 40,000 to 50,000 pounds total pressure.

The finished record is placed in a trimming lathe and the fin or overflow is shaped off. After this process the record is tested on an ordinary phonograph. After testing and labeling the records are ready for the trade.



The Pictures Above, Viewed from Left to Right, Illustrate the Successive Steps Followed in Making Phonograph Records. The Original Wax Record on Which the Music is First Recorded, is Placed in an Electro-Plating Bath; Fig. 3 Shows How the Copper Deposit is Stript Off, and This in Turn Placed in an Electro-Plating Bath, the Second Matrix Being Stript Off and Used as the Stamping Die in Producing the Records, as Shown at Fig. 5.

PLAN TO HARNESS SUN

The next great achievement of science will be utilization of the sun's rays to provide light, heat and power.

This prediction was made recently by Dr. A. D. Little of Boston in an address at the *International Convention of Chemists.*

According to Dr. Little, the sun alone is worthy of scientific investigation as a source of energy. He said he presumed chemistry would play an important part in harnessing solar rays to supplant dwindling supplies of coal, petroleum and other sources of energy.

Attacking the claim that labor is the great producer of energy, Dr. Little asserted that a few men with brains could apply scientific principles to accomplish what mere muscle would not do.

"Hydraulic devices," he said, "enable one man to operate the locks of the Panama canal, and the desert of Sahara, with its 6,000,000 square kilometers of area, receives daily solar energy equivalent to that of six billion tons of coal. The world awaits the genius who will convert radiant energy into electric currents."

Many of the miracles of the New Testament are every-day acts of master surgeons. Dr. Charles Baskerville, laboratory director of the College of the City of New York, declared in an address before the *International Conference of Chemists.*

"An inventory shows," he said, "that more changes and greater changes have taken place in civilization during the past 150 years than in all the preceding centuries. Practically all the chemical elements have become known since 1772; all we know about electricity, ideas of dynamics, steam and gas engines, water and air, ability to see the invisible, X-rays and radio-activity. . . . All these things have brought the individual into touch or into communication with all other individuals of the world. Thus science has made human history at an overwhelming speed.

"In it all, man acquired, quite naturally, a growing smugness of material omniscience. The pulpit has sought to harmonize what it did not understand with phraseology 15 or more centuries old."

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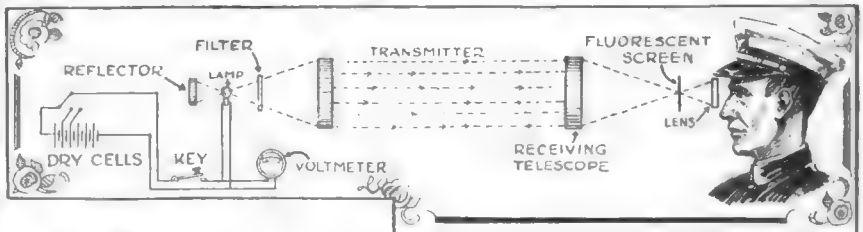
Invisible Ray Signalling



The Accompanying Diagram and Photos Will Give a Good Idea as to the Appearance and Operation of the New Invisible Ray Signaling Apparatus, Which was Developed by Two Well-known American Electrical Engineers During the War. Dr. Louis Bell and Norman Marshall of Boston are the Inventors, Dr. Bell Being Shown at the Left Using the Apparatus. When the Invisible Ray Arrives at the Receiving Instrument, it Impinges Upon a Fluorescent Screen and the Dot and Dash Flashes are in Turn Viewed Thru a Lens in the Manner Shown. A Range of Five Miles was Attained Using a 25 Watt Lamp.

PHOTOS COURTESY BOSTON HERALD

DURING the war much attention was given to the problem of transmission of intelligence by the invisible ether rays. The inventors, Dr. Louis Bell and Norman Marshall, of the system we illustrate, departed from the ultra-violet ray to this extent; that they selected, from the ultra-violet region of the spectrum, a portion which could be operated with glass mirrors and glass lenses, doing away with the necessity of quartz and yet operating in perfect secrecy.

The apparatus uses about 2 amperes of current. Only 25 watts were expended on the light, and it was found that it could be used in rain and falling snow, as the atmosphere had little effect upon it. The light used was a gas filled 6 volt lamp taking a two ampere current. It was run above normal so its life was undoubtedly short.

The diagram illustrates the general layout of the apparatus. At the bottom is seen the telegraphing circuit with its regulation key, whose motions operated the lamp for the dot and dash code. The lamp was set in the focus of a Mangin mirror. The rays past thru a filter, and, as they diverged, they were received by a condenser, which brought them into parallelism. At the receiving station which is indicated in the upper part of the cut, a second condenser focused the rays upon a fluorescent screen coated wth barium platinum cyanide. The light-spark was observed thru a regular prismatic binocular. As experimented with during the war the current was supplied by a dry battery, small enough to be carried at the belt. It is characteristically said that all the traditions of the ultra-violet ray were transgrest. With the dry battery it was thought that a mile could be covered, but the distance could be greatly extended by using a more powerful battery. Eventually a 30 pound outfit capable of working over 3½ to 5 miles was produced. In the later form of the instrument two telescopes are used side by side; one being used in transmitting and the other in receiving signals. In the former are mounted duplicate lamps, the filter, eyepiece and transmitting lens; the latter contains a condensing lens, with the fluorescent screen at its focus, and an eyepiece. It is interesting to note that clear glass was used in these lenses.

Radio in a Nut-shell

A distinct novelty and freak in the realm of wireless is this miniature receiving instrument built in a cocoanut shell. It is a sample of the craftsmanship of Mr. C. Sanders of Peckham, England, and will receive any messages from ships, coast and land stations, reproducing speeches, music and concerts on all wave lengths up to 1700 meters.

BORES HOLE LENGTHWISE THRU PIN.

When wishing to indicate the smallest thing that the average human brain can conceive, one usually thinks of a pin point. Imagine then the delicate and careful skill required to drill a hole lengthwise, thru a pin, the hole to run

(*Continued on page* 780)

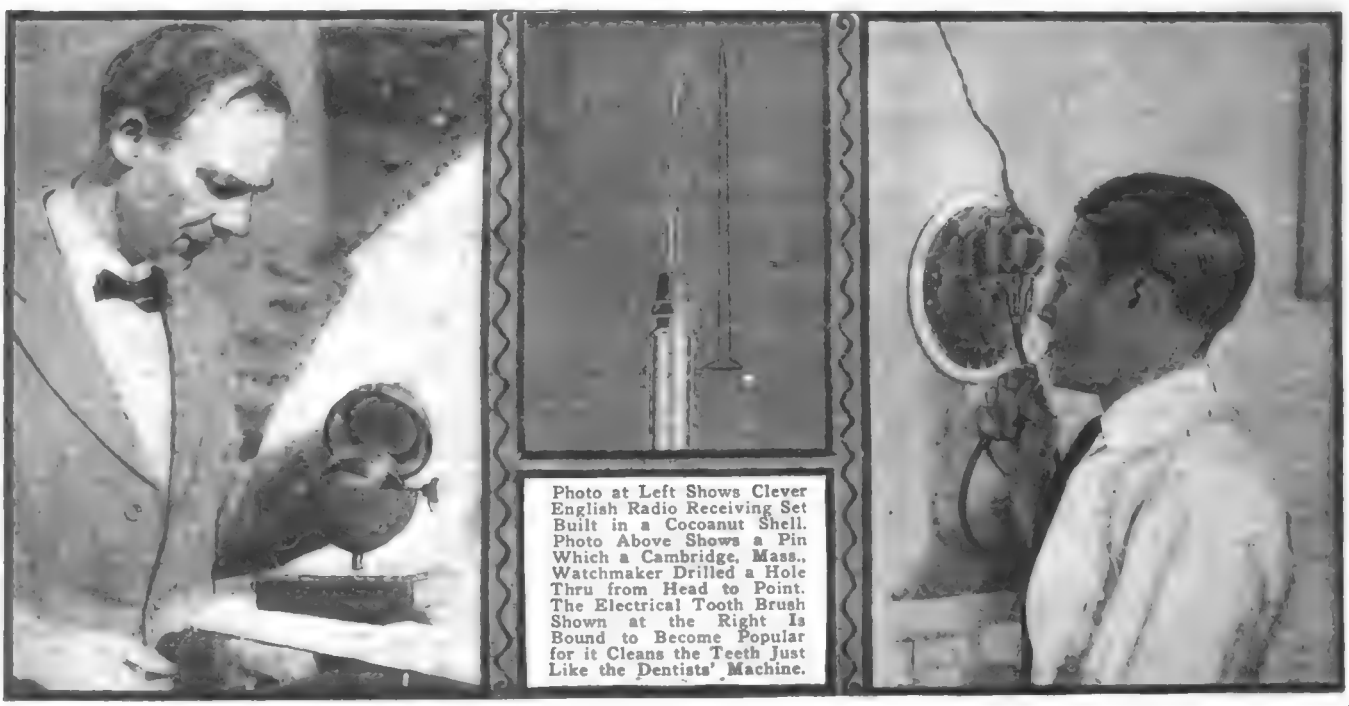


Photo at Left Shows Clever English Radio Receiving Set Built in a Cocoanut Shell. Photo Above Shows a Pin Which a Cambridge, Mass., Watchmaker Drilled a Hole Thru from Head to Point. The Electrical Tooth Brush Shown at the Right Is Bound to Become Popular for it Cleans the Teeth Just Like the Dentists' Machine.

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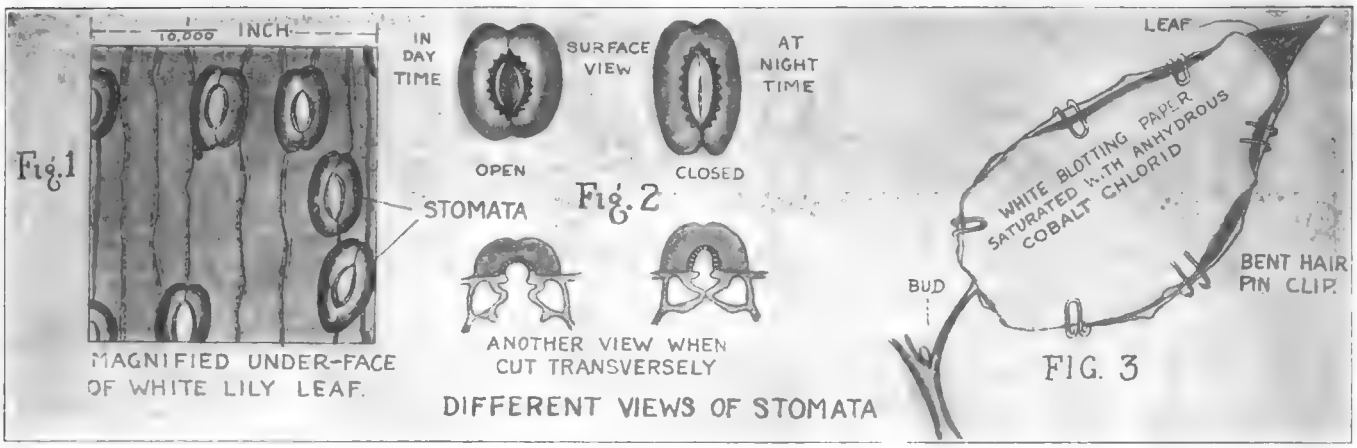
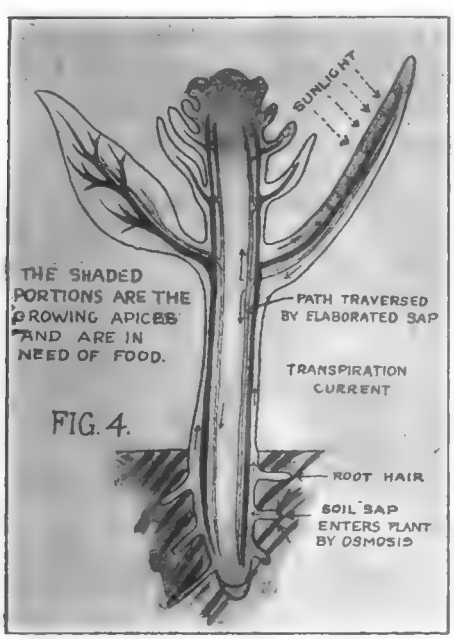
The Physiology of the Leaf

By JEAN CAMPS CAMPINS



Diagrams Above Show Us the Important Sections of a White Lily Leaf—the Stomata which has to do with the Very Life of a Plant. Plants are Constantly Removing Carbon Dioxid from the Air and Giving Out Oxygen.

COMPARATIVELY little has been said about the *leaf*, popularly so-called, in its maintenance of life and especially of our life on the globe. Scientifically speaking, the green leaf is absolutely responsible for our food supply and welfare; tho humble in its appearance, it is the supporter of animal life, and, therefore, holds one of the greatest positions in Nature; again, it is constantly purifying the air by removing the excess of carbon dioxid, thus keeping all animal organisms alive. Moreover it absorbs radiant energy, storing it up as potential energy, mostly in the form of food. As an instance of this no better example can be selected than when a piece of coal burns; coal, as we know, is the remains of plants of past ages; now, the cheerful fireside glow and its snug warmth are simply the liberation of the


SUNLIGHT
THE SHADED PORTIONS ARE THE GROWING APICES AND ARE IN NEED OF FOOD.
PATH TRAVERSED BY ELABORATED SAP
TRANSPIRATION CURRENT
FIG. 4.
ROOT HAIR
SOIL SAP ENTERS PLANT BY OSMOSIS

The Way the Plant Secures Its Nourishment Is Clearly Depicted in the Above Diagram. Note That the Leaves of the Plant Act Practically as the Lungs in a Human Individual, in That the Sap Flows to the Leaf Where, by Means of the Stomata Carbon Dioxid Is Given Off in the Night-Time, but During the Day the Plant Absorbs Carbon Dioxid and Gives Off Oxygen.

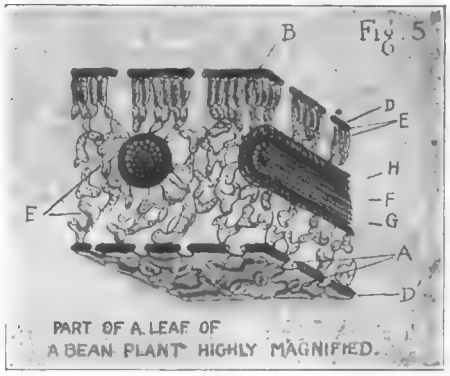
light and heat of the sun which has remained dormant for millions of years.

Externally the leaf is a lateral outgrowth of the stem placed at certain definite points and with such symmetry thereon that it can obtain an adequate amount of light. If its surface be examined under the microscope, it is seen to be covered with myriads of small mouths, each little mouth having its own pair of lips, which are quite analogous to our own lips. Each little mouth technically called a *stoma* (derived from the Greek word for mouth) connects the inside of the leaf with the outer air, whereby the leaf, and therefore, the plant can breathe in exactly the same sense as we do, in that we absorb oxygen and give out carbon dioxid and water vapor The above process is called *respiration* and is common to both kingdoms. It has a wider sense in the animal kingdom than in the vegetable kingdom, being in the latter restricted only to the absorption of carbon dioxid and the liberation of oxygen; the other part of the process, namely, the giving off of water vapor, being termed transpiration.

Observation shows that the stomata are more numerous on the under surface than on the upper of a leaf, and this can be proved by the following experiment on transpiration. Make a weak solution of cobalt chlorid and dip a sufficiently large piece of thick white blotting paper in it; dry it and dehydrate the salt on it by further heating. The paper now has a distinct blue color. Cut two similar pieces the size and form of a sufficiently strong leaf over which it is to be placed. One piece is placed on the upper face and the other piece on the lower. Where the plant is in an advantageous position, an ordinary photographic printing frame is found to be exceedingly handy for keeping the paper on, and the ordinary thin blotting paper can be used. Strong hairpin clips are, however, found very handy for this purpose if the printing frame cannot be used. You will notice that the paper fixt to the lower side assumes the red color far more quickly than the other one; the salt on the lower side gets hydrated quicker than that on the upper side, and it is evident from the proceeding that the upper surface of the leaf loses much less water vapor than the under.

Transpiration is very important and essential to the welfare of the plant; whereby it concentrates by evaporation the very dilute solution of salts absorbed by the root, thus also causing currents in the body of the plant, which aid the root in absorbing crude food and help the elaborated food (sap) in finding its way to the various parts of the plant, which need it. From experiments too long to be described here, we know that the green leaf absorbs carbon dioxid and gives out oxygen. This process is known as carbon-assimilation or photosynthesis and sometimes as photosynthetic-carbon-assimilation to differentiate it from chemosynthetic carbon assimilation of certain bacteria. From very simple experiments (water-culture) we learn that the plant gets all the elements required for its growth from the soil, with the exception of carbon, and this we have said comes from the air.

Now the main function of the leaf is to act as a laboratory for the manufacture of organic food from the carbon dioxid of the air, and from the watery solution of salts supplied to it by the earth. This process requires a certain amount of energy and it is the sunlight that supplies this. This energy is transformed into a convenient form by the green coloring matter of the leaf termed chlorophyll, thru the agency of the little masses of living matter termed chromatopores, they themselves being saturated with the pigment chlorophyll. These chromatophores which are saturated with the pigment chlorophyll are called chloroplasts, to differentiate them from other chromatophores which bear, and are saturated with other pigments, such as those that are found in other leaves, for instance the petals of the blossom. These other chromatophores are termed chromoplasts.



Greatly Magnified Section of a Leaf from a Bean Plant; D', Under Skin; D, the Upper Skin; A, Stomata; E, Central Leaf Tissue Divided Into Two Layers; B, the Upper or Palisade Tissue, While G, H and F are the Conducting Tissues, One Portion of Which Consists of Tubes (Wood Vessels) Which Bring the Crude Sap to the Leaf; and Another Portion Which Carries Away the Sap Elaborated by the Leaf.

(Continued on page 80

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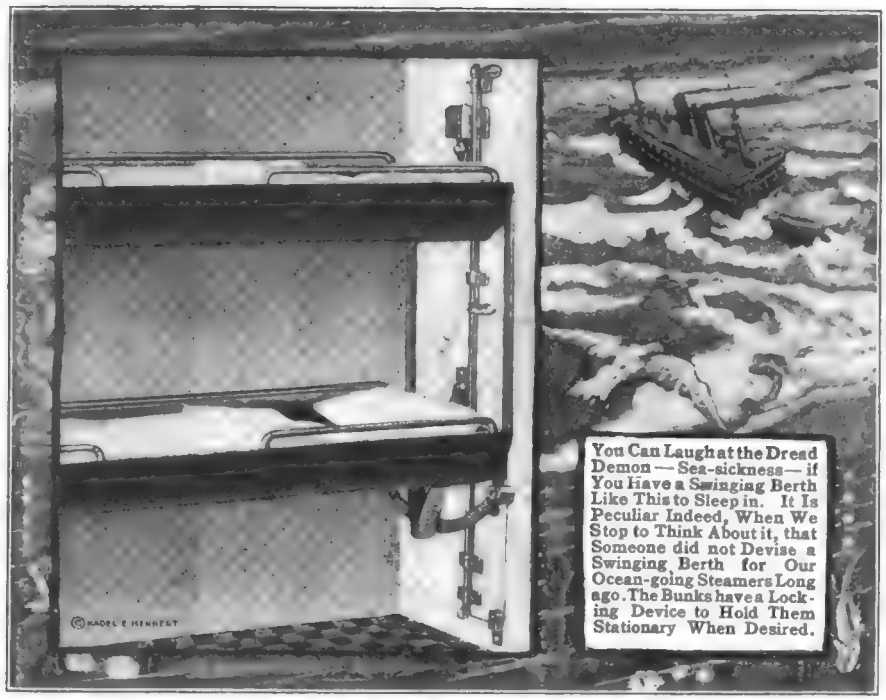
Rocking Berth Prevents Seasickness



You Can Laugh at the Dread Demon — Sea-sickness — if You Have a Swinging Berth Like This to Sleep in. It Is Peculiar Indeed, When We Stop to Think About it, that Someone did not Devise a Swinging Berth for Our Ocean-going Steamers Long ago. The Bunks have a Locking Device to Hold Them Stationary When Desired.

In the old-time New Bedford whaling ships, swinging berths were often placed in the captain's stateroom. This conduced to the repose of the "old man," as the captain was called. It is told that Portuguese captains objected to them. They did not wish to be lulled to sleep by the gentle motions of their swinging cot, while the ship might be rolling down to her beam ends.

However the modern traveler is not concerned with the rolling of the ship, as long as his internal anatomy is not affected. But many of us are subject to sea-sickness, and for the benefit of such weaklings, the swinging bunks illustrated herewith have been devised.

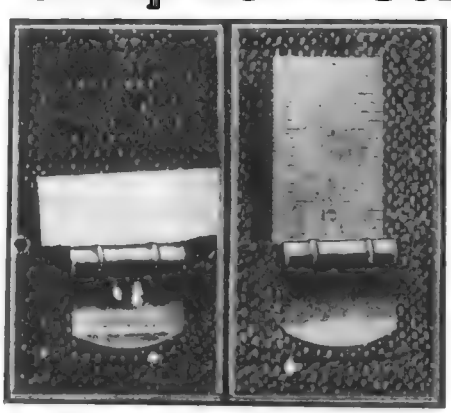
The trough-like shape of the cot-body in itself suggests security. Then on the inner side is a long hand bar to still further fortify the occupant, while on the outer side there are two such bars with an interval between, to enable the passenger to more easily creep in. The pair of cots are hung on a pivot so as to be free to swing laterally. This motion is restricted, as required, by a braking mechanism, the cord, controlling this, is seen below the lower berth.

Any invention to subdue the dread demon of the sea is to be welcomed. Any number of inventors, including such eminent men as Bessemer and Sperry, have done their best to overcome its ravages.

There is one very curious variation on mal de mer—this is land-sickness. Some people do not suffer at sea, but on landing they have, it may be for several days, an attack of this aggravating illness. No one has invented anything to overcome this last named trouble.

A Safety Clasp for Pocket Rules

A very clever and simple clasp, adapted to hold securely in one's pocket, letters, cards, or other flat articles, is illustrated herewith. The pet implement of machinists is a steel rule, and this he parts company with, perhaps never to see again, by two processes; one the lending of it to someone who forgets (?) to return it, the other by dropping it out of his pocket, for steel rules are notoriously slippery and liable to disappear by either of the routes we have specified. One of these sources of loss is perfectly taken care of by the clasp. It is a doubly bent piece of thin steel spring fortified at the bends by embost ribs, and it really is an admirable adjunct for the pocket, and the unassisted pocket sometimes fails us. We are sure that it will interest many of our readers.



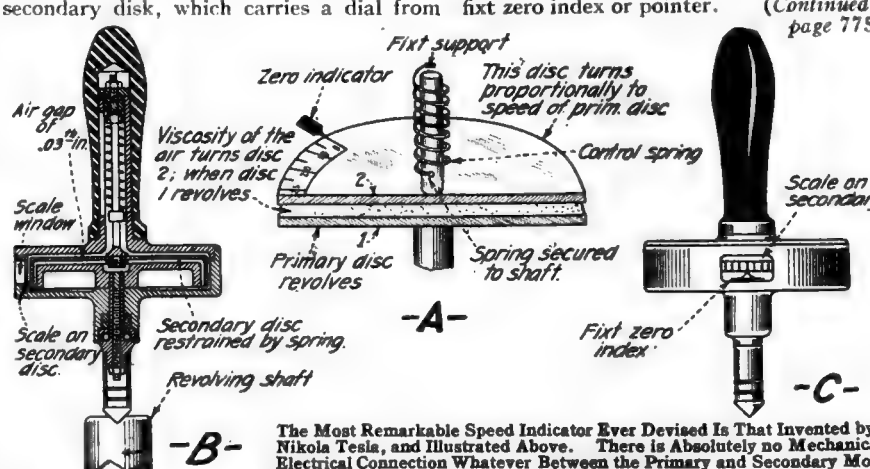
Probably More Steel Rules Have Been Lost by Falling Out of People's Pockets Than in Any Other Way. As These Graduated Steel Rules, Even in the Smaller Sizes, are Fairly Expensive, the Owner Does Not Like to Lose Them, so This Safety Rule Clasp Should Find Many Friends. The Clasp Will Also Retain Notes or Cards in the Pocket.

Speaking of steel vest pocket rules that go to the land of the missing, brings to mind a young machinist, whom we knew some years ago. One of the first tools of his trade that he invested his hard earned money in, was a steel rule, beautifully graduated with every conceivable fraction of an inch—fourteenths, twenty-eighths, twelfths, tenths, hundredths, etc. Says he, "I'll fool them all, I'll drill a hole thru the end of my rule and fasten it to a watch chain," but he gave up this idea when he found that the rule was tempered quite hard. Not wishing to anneal the rule and perhaps spoil the enamel in the graduations, he found himself without the protection he had conceived of. This is where the pocket rule clasp would have come in nicely.

Tesla Air-Friction Speed Indicator

ONE of the latest wonders of applied science perhaps is the new Tesla speed indicator put out by the well known Waltham watch concern. Contrary to all previous designs and schemes employed in producing a direct-reading speed indicator or tachometer, as the engineers call it, Dr. Nikola Tesla, the famous electrical and radio expert, has here shown us a new trick in the physics of gases and liquids.

As becomes clear from the accompanying illustrations, this direct-reading speed indicator is supplied and calibrated to read in revolutions per minute, or in miles per hour, et cetera, according to the use to which the instrument is to be put; there is no direct mechanical connection between the driving and driven members of the instrument. In a few words what happens is this: When the first cup or disk secured to the driving spindle is rapidly rotated, by having its pointed end placed in contact with the engine- or motor-shaft for example, the thin layer of air, about .03" thick, between it and the secondary disk or cup *acts by virtue of its viscosity* or friction to drag around the secondary disk, which carries a dial from which the speed is read off by means of a fixt zero index or pointer. (*Continued on page 775*)



The Most Remarkable Speed Indicator Ever Devised Is That Invented by Dr. Nikola Tesla, and Illustrated Above. There is Absolutely no Mechanical or Electrical Connection Whatever Between the Primary and Secondary Moving Elements of This Instrument, Which is Calibrated to Read Directly in Revolutions per Minute, or Miles per Hour. Air Friction or Viscosity of the Air Accounts for the Drag Which Turns the Indicator Disk.

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Meet Miss Violet Ray

By A. H. LYNCH

An Enterprising New York Electrical Shop Has Adapted a Novel Window Attraction. A Violet Ray Apparatus Is Arranged Inside the Show Window With the Vacuum Electrode Mounted Against the Glass on the Inside; When a Person Places His Hand on the Outside of the Glass Over This Position, the High Frequency Electric Discharge Can be Distinctly Felt. Miss Violet Ray Meets Thousands Every Day.

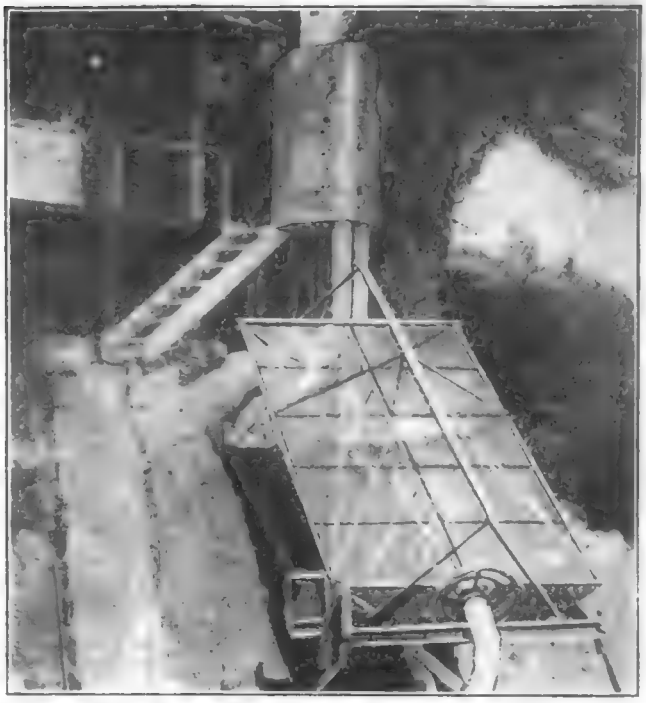
YOU'D be surprised to see how many fellows, and girls too, drop enough of their bundles to allow them to place their hand on the spot of the window shown in the accompanying illustration. The sign in the center bears the entire story in a very convincing manner, it is white with violet lettering and reads thus: "Violet Ray—Free Treatment—Touch Center." The "Touch Center" portion is directly around a circle in the center of the sign and is just large enough for one of the glass applicators, which are sold with violet ray machines to be inserted into it.

Nearly everybody has heard or read something of "violet" rays, but there are still a great number who have not seen and felt the rays.

A stand may be made from lighting fixtures, which will support one of the glass applicators, which may be placed in any convenient section of the window and made to rest against the inner surface of the window-pane. The lead from the applicator is connected to the outfit in the usual manner and the plug is connected to a lamp socket or service receptacle; Miss Violet Ray is ready to meet all comers. Where it is desired to keep the outfit working for long periods at a time, it will be of advantage to screw the plug which ordinarily goes into the lamp socket, into a "flasher" and screw the flasher into the socket. The action of the violet ray outfit will then be intermittent and the coils and the contacts will have a chance to cool, so that they will operate with less wear, as well as with a more constant flow of current. The rays will pass through the glass without doing a bit of damage. To provide a good "ground" the expert placed a cake of ice near the bottom of the window. The water from the ever-melting ice provided a perfect ground.

Cooking With Sunshine

By C. G. ABBOT



A Remarkable Solar Cooker Built by Mr. C. Abbott, a Scientist of Washington, D. C., which Proved very Successful. It Remained Heated Throughout the Night, Owing to the Heat Retained by the Oil.

THE solar cooker which I recently described before the National Academy of Sciences was an experiment and has not been developed for the market.

Its principal features are a concave cylindric mirror, 7 by 10 feet, rotated by a cheap spring mechanism about a blackened metal tube, parallel to the axis of the earth. In this tube engine cylinder oil is heated by the focus of the sun's rays, and rises up to an oil reservoir in which the ovens are immersed and from which a return tube completes the oil circuit; similar to a water-back. The mirror surface is of sheet aluminum secured to a steel backing of proper curvature. The mirror is covered with glass to prevent loss of heat by air convection. The pipes and reservoir are well protected by heat insulating materials.

All kinds of cooking except frying were carried on with great success thruout the summer of 1920 on Mt. Wilson.

New Duplex Soldering Torch

BY using the gas derived from alcohol, and that from gasoline, and mixing the two in one flame, a long pointed, intensely hot flame is produced much longer and hotter than either fuel will produce, if used singly. By using these two fuels in preference, as either of them are easily obtained anywhere, this torch will do all classes of soldering, light brazing, and melting of refractory metals.

By Means of the Unique Blow-Torch Here Illustrated in Use, All Kinds of Soldering Work Can be Accomplisht by the Home Mechanic, and Very Creditable Work Will Result.

Primarily, however, it is designed as a soldering torch, and was invented by an experienced electrician to do away with the cumbersome, dangerous and unreliable blow torches now upon the market, and will do all classes of work now being done by them.

An experienced mechanic is not needed to operate this torch. Anyone can operate it by simply striking a match, and it is ready to use. A child can operate it without danger of premature explosions, as it is designed to operate without air in the containers.

Soldering may be done direct with this flame without the use of a cumbersome and unwieldy copper. All that is necessary to do to use the torch is to light a match. Apply to burner, blow thru tube attached to the saturator compartment, after first fluxing and cleaning the metal to be worked upon, and by applying the flame of the torch at about a 60 degree angle, one can follow up this flame with the solder, and it will almost immediately flow like water, filling all cracks and interstices, and making a joint that cannot be broken through ordinary usages. Other kinds of fuel may be used in this torch.

In any case it is necessary to use a satisfactory flux. There are on the market several excellent non-corrosive soldering fluxes for use in making electrical joints, and these will successfully solder all of the ordinary metals excepting iron or aluminum. Muriatic acid, *cut* with zinc, is commonly used in soldering iron. Aluminum joints have to be soldered with special aluminum solder.

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Fortunes from Little Things

By CHARLES FREDERICK CARTER

No. 6 Princely Profits from a Pencil

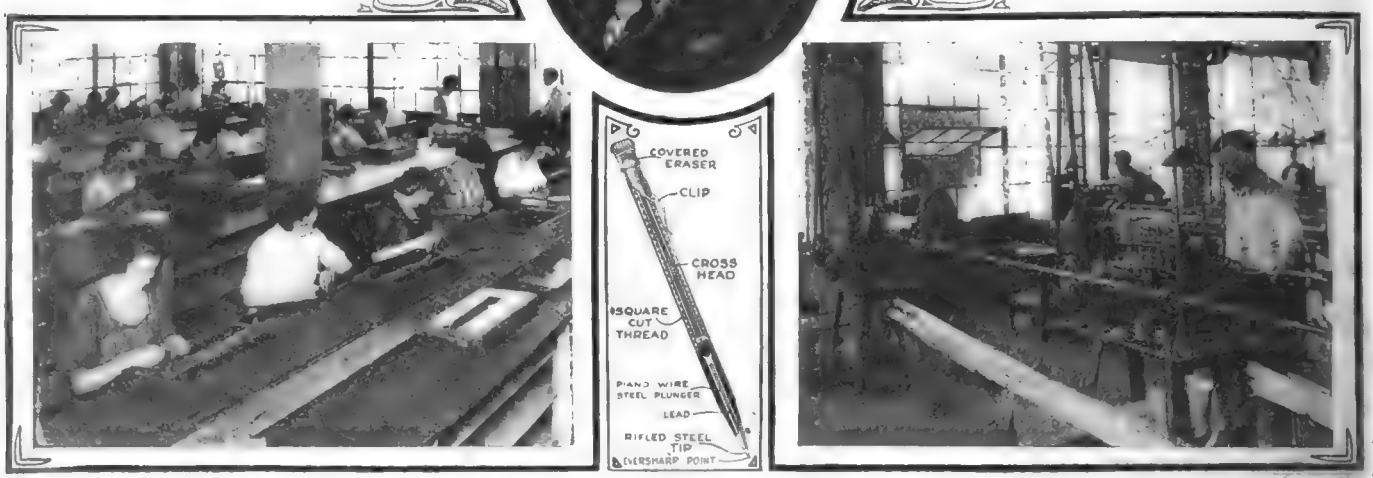
IF you were offered your choice of a sum equal to the net sales of the Remington Typewriter Company for the year 1919, or of a sum equal to the net sales of the Eversharp Pencil for the same year, which would you choose? Think carefully, now.

Well, you're wrong. To be sure the net sales of the Remington Typewriter Company for 1919 were $3,327,745, a sum well worth picking up, even if you couldn't buy much with it at present prices; but Eversharp sales topt this by no less than $335,158. The Eversharp pencil was first made eight years ago, and first advertised only four years ago; yet its earnings are climbing so fast that it takes two men to see them go up; one to say "here she comes," and the other to say "there she goes." In 1918, the first full calendar year after the advertising campaign began, net sales were $1,144,138; the next year $3,662,616, or more than two and a half times the figures for the preceding year. For the first six months of 1920 the net sales were $2,823,521.

The secret of this almost incredible success is that the Eversharp is such a simple writing machine that a child can run it. Eversharps are so handy to draw pictures with during the children's hour that—well, next morning after reaching his office, Dad makes a vain search thru his pockets to an obligato of expletives, then goes, or sends, out and buys another Eversharp.

And, besides, Eversharps retail at $65 each—two-thirds the price of a typewriter, although the latter weighs almost as much as a steam roller, while you'd never feel the weight of a whole pocket full of the pencils. But then the $65 Eversharps are of 14 karat gold while the typewriter is not. There are cheaper ones for the proletariat, some for as little as 50 cents. The average price of all the millions of Eversharps in sixty different styles sold in 1920 was $1.44.

So far as outward appearances go the Eversharp is the same thing as those smooth-bore automatic pencils of the McKinley era. All you had to do with the old smooth-bores was to push on the top and the lead came out at the bottom. When you prest the point on the paper, expecting to write, the lead modestly retired within its shell like a turtle drawing in its head, so you repeated the process until you got mad and fired the blamed thing out of the window. Or, haply you forgot to finger the muzzle of the old smooth bore as you prest the top, and there being nothing to prevent, the whole lead fell to the floor where it broke in so many pieces that they had to be gathered up in a dust-pan.



The Inventor of the Famous Eversharp Lead Pencil, Mr. C. R. Keeran, Whose Likeness Is Reproduced Above, "Started Something"—as the Saying Goes—when He Thought Out and Perfected This Well-known Writing Implement. This Interesting Lead Pencil Revolutionized the Pencil Industry We Might Say, and It Just Goes to Show How a Little Real Brain-work Can Affect an Entire Industry. The Photos at Right and Left of the Group Show Views in the Factory Where Eversharp Pencils are Manufactured at the Rate of 50,000 per Day.

A test will prove that the Eversharp isn't a bit like that. The Eversharp is no smooth-bore; it is *rifled;* and there is just as much difference in the effectiveness of smooth-bore and rifled pencils as between the same varieties of cannon. That is all there is to it.

If you have keen eyesight run the lead out of your Eversharp for a quarter of an inch and examine the protruding end carefully. You will see minute grooves plowed in the lead by tiny projections just inside the steel-tipt muzzle. Do not be afraid the lead will take cover at the first alarm, for it can't. It is forced out by a plunger operated by a screw, for you twist the Eversharp instead of merely pressing on the top. When the lead is out it is out for keeps. The rifling prevents the lead from turning in the pencil; and as it is held at an angle in writing the lead automatically sharpens itself as it wears away.

C. R. Keeran, of Chicago, invented the Eversharp pencil and formed a company to manufacture it. Inventions, however valuable they may be intriniscally, never get anywhere unless and until they are backed by great manufacturing and merchandising skill reenforced by adequate capital. Keeran's company lacked these essentials. It undertook to have the pencil parts manufactured in various factories and assembled in its own work rooms. Of course this proved to be utterly impracticable.

Next, arrangements were made with the Wahl Company, manufacturing adding machines, to make the pencil at its plant on the West Side in Chicago. John C. Wahl, Vice-President and Chief Engineer of the Wahl Company, was a mechanical genius and the inventor of the Wahl adding machine. The concern had assembled a staff of executives who were watchmakers by training, so they possest more than ordinary skill and knowledge in turning out small, standardized parts. By the way Matthias Baldwin, the founder of the great Baldwin Locomotive Works, was a watchmaker by trade. This coincidence suggests that when you want things made right, whether it is a locomotive or a pencil, go to a watchmaker.

Now the Eversharp pencil, simple as it looks, is a wonderfully fine bit of mechanism, consisting of no fewer than sixteen parts. It could never be manufactured and sold at any price within reason unless it was turned out in vast quantities by machinery marvelous for its ingenuity. John C .Wahl and his staff of clever watchmakers planned the series of machines which turn out the parts automatically at the rate of 50,000 pencils a day. Everything is done by automatic machines. Even the little magazine in the top of the pencil which holds six leads is loaded automatically. So, also, are the little containers for extra leads. The two peculiarly formed parts of the lead magazine gave a lot of trouble at first but now tubing is merely fed into a machine which turns them out formed and finished ready to have the ends soldered on. Even the soldering is done by an automatic electric machine. Each machine pours out completed magazines at the rate of 12,000 a day.

The completed parts pour out on to a conveyor belt which runs along in front of an assembly bench, at which nimble-fingered girls sit all day long, helping themselves to parts as they need them. It has taken three years hard work to perfect the manufacturing processes, but results have been worth the trouble.

(Continued on page 773)

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New Scientific Appliances

A PERMANENT NEEDLE FOR THE PHONOGRAPH

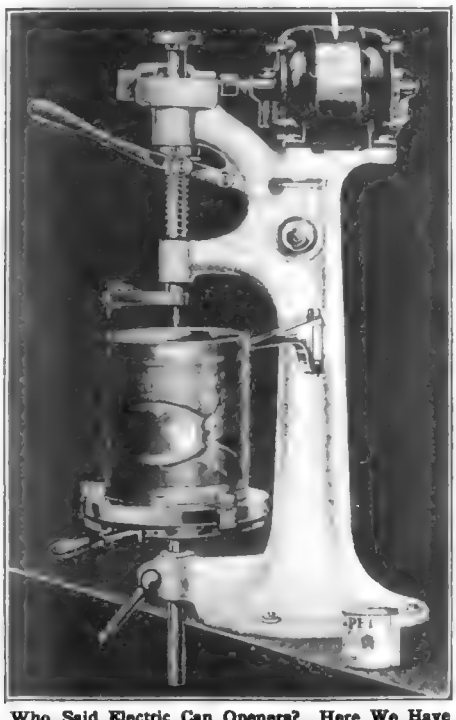
The annoyance of constantly replacing a needle on the phonograph for each record is considerable. The invention we illustrate eliminates this trouble. A fine wire 9 inches long is coiled within the appliance and by

A Renewable Needle for Feeding Down a Wire Which Constitutes the Playing Stylus, Here Takes the Place of the Usual Phonograph Needle. The Amount of Its Projection Affects the Playing, Making It Loud or Soft.

turning the star wheel it can be turned down as it wears. It is calculated that each inch of the wire will play approximately 3,000 records, so that, with average playing, the nine-inch wire may be expected to last some twenty years. It consists virtually of a feeding apparatus, with a little star wheel by turning which the wire can be pusht down. If the star wheel is turned in the wrong direction no harm is done as the wire then remains motionless. While it is supposed to project only 1/16 of an inch, its loudness of playing can be affected by changing the amount of this projection. It certainly seems to be a distinct advance over the old-fashioned individual needle.

ELECTRIC CAN OPENER

Mr. Hobson, in our "What-to-Invent" monthly department suggested the need in industry of a motor driven can-opener. We illustrate in our illustration a product of a Jackson, Mich., concern who have exactly anticipated Mr. Hobson's suggestion. Here we have a machine driven by power which, operating on the lines of a washer-cutter, neatly cuts out the top of a can and does it very rapidly, the operation taking but a few seconds for each can, so that a speed of 12 cans per minute can actually be attained. The can is opened to its fullest diameter, according to the setting of the knife and the edge of the tin is left smooth and unjagged so as not to cut the hand. Hotels, restaurants, large consumers of paint and many other businesses have occasion to open up many cans, and for them this machine will, we believe, be found most useful.

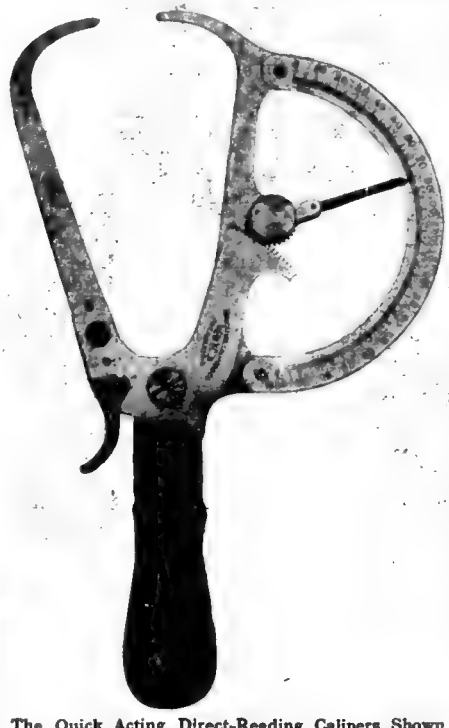


Who Said Electric Can Openers? Here We Have the Actual Machine, Which Will Open Canned Fruits, et cetera, at the Rate of Twelve Cans per Minute or More.

INDICATING CALIPERS READ 1/100 INCH AND FINER

There are two kinds of calipers in use. In one class the jaws are set by trial to give the exact size of the article being measured; the jaws are then laid upon a rule and their opening is measured. The other class of calipers has a scale on which the opening of the jaw is directly indicated in any desired unit of measurement.

The calipers we illustrate are of the second variety. They are provided with



The Quick Acting Direct-Reading Calipers Shown Above are Making Many Friends Among Machinists and Electrical Workers. It Will Gage the Thickness of Stock to 100th of an Inch, and Even a Fraction of This Value Directly, Without Having to Convert Decimals to Fractions, or Vice Versa.

a spring tending always to close the jaws and thus do away with lost motion. One of the jaws carries a rack on an extension, which gears with a pinion, so that the motion of the jaws of the calipers is indicated on a scale, over which the end of an index attached to the shaft of the pinion passes. The effect of this is to magnify the movements, so that a very small change of the points will show in magnified degree upon the semi-circular scale traversed by the end of the index hand. Sometimes it is desirable to set the opening of the calipers to a given measurement, so as to constitute a gage. A screw is provided for the purpose of doing this setting, and of holding the jaws in position when so set, and the magnified scale enables the setting to be done with great accuracy.

The index hand can be set to one side or the other after adjustment so as to compensate for any wear of the gear teeth. The instrument is supplied for English or for Metric readings.

ELECTRIC UTILITY PLANT FOR FARMERS

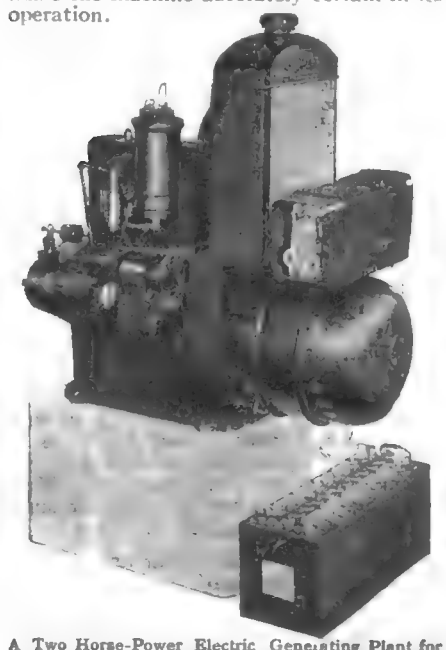
Many farmers are now equipt with electricity on their farm and the Unilectric vacuum pump and utility motor will do a lot of work and tend, as the saying is, "to keep the boys on the farm." The machine

A Mechanical Dairymaid Supplanting the Young Lady, Who Remarked to the Money-Seeking Suitor, "I'm Agoing a-Milking, Sir," She Said."

weighs but fifty pounds; it has a one-quarter horse-power motor which can be supplied by either direct or alternating current. By reduction gears the driving speed is reduced to 350 revolutions per minute and three sizes of driving pulleys are provided for belt work. The motor can be run from any electric lamp socket. A typical size is 32 volts with 8 amperes. One of its functions is to produce a vacuum for milking cows, as here illustrated for example.

A BATTERY-LESS FARM LIGHTING PLANT

This efficient little unit, giving some two horse-power and supplying current at a pressure of 110 volts is made as nearly trouble-proof as possible. It is driven by an internal combustion engine of four cycle type, with four cylinders, of 2" bore and 3" stroke. The gasoline engine is rated at 3½ horse-power and it develops two horse-power at the electrical generator. There is no battery, except for the starting purposes, and this is automatically charged exactly as is the starting battery on automobiles. It gives a direct current and its size and power is such that it is no toy, but is a real working mechanism for doing real and severe work about the house and farm in isolated districts, where there is no power line to be drawn upon. The engine is water cooled and every precaution is taken to make the machine absolutely certain in its operation.



A Two Horse-Power Electric Generating Plant for Isolated Houses Which Supplies a Flickerless Lighting Current Without Any Storage Battery—a Goal Long Attempted by Designers of Isolated Lighting Plants.

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"Razor Blade" Contest Awards

SOMEHOW it seems that our contests of late are growing better. When we had our last contest, we intimated that it was the best one ever, and so it was, but the Razor Blade Contest certainly capped the climax. We may truthfully say that it proved to be a more successful contest than all of the others combined, and we have had some good ones in the past. We cannot say why it was such an unqualified success, but there have been more entries in the Razor Blade Contest than in any other. There have been received over 10,000 pieces of mail, and close to 200 actual models.

You can imagine the editor's task, to decide intelligently between these many entries and manuscripts, but we wanted something useful and original made from razor blades, and we believe, that by awarding the first prize to Mr. Bade, who constructed a simple chemical balance, we accomplished this. The scale is both easy to make, and distinctly useful. Moreover, it can be made without many tools. It is true, that there was another chemical balance entered, but while it was very sensitive, it was also difficult to make, and the making required many tools. Moreover, it is not the same sort of a scale, as the one which secured the first prize. It is rather large, and more or less clumsy, but as we said before, it is quite sensitive, so much so that it will weigh the writing on a piece of paper, which certainly is "going some", as expresst in the vernacular.

There have been duplicates galore. There was not one entry received, that was not duplicated in some form or other. Thus, for instance, there have been variable condensers made from razor blades. There were no less than 25 such entries for this alone. Then, of course, we have the inevitable paint scraper of which there have been several hundred. Pencil sharpeners were next, with about 150 entries. Then there were all sorts of household utensils for cutting and slicing vegetables, and there were erasers, paper cutters, newspaper clipping cutters, twine cutters, mouse traps that decapitated the victim, can openers and corncutters, both for feet and for vegetables. Then there was the large class who took the safety razor, and went to the trouble of softening the steel, and forming all sorts of devices from the soft steel thus formed.

In the illustrations we have shown only a few good and practical uses, and we would not be over surprised to see a lot of them appear on the market very shortly.

All in all the contest was a huge success, and we compliment our contributors, and readers as well, for the interest taken.

THE first prize, a pretty looking check for $50.00—yes sir—50 cold simoleons, goes to Mr. Bade for the construction of a chemical balance. This consists merely of a long glass tube, at either end of which are mounted two pans. A slidable depending arm which incidentally acts as the pointer, is mounted on the tube. This may be taken apart. An old razor blade is fixt to the cover of a box, so that the balance is portable in its arrangement. A set of weights goes with the outfit. It was not necessary to submit a model of the device in order to enter it in the contest, but so many models were submitted that we are rather fortunate in being able to present photos of actual models to our readers.

The $25.00 second prize award goes to Mr. Charles F. Hutter, of Austin, Texas. It is a simple cord cutter and holder. The razor blade is mounted within a suitable sheath at the end of a flexible spring wire tube. Rings along this tube allow the cord to pass to the forward end and in the vicinity of the cutter. After a package is tied, a slight movement on the part of the cutter will sever the tying cord. The device may be screwed to a table or suspended from a string, Fig. 2.

Altho not a particularly humane method of ridding the house of rats, the winner of the third prize has stept forward with a rat and mouse trap which is positively efficacious. He is Henry M. L. James, of Richmond, Va., and $15.00 goes to him for his idea. This rat trap has two entrances, each guarded by a long tapering passage way lined with razor blades pointing *inward*, covered with a glass slide. The pest can worm its way toward the bait placed in the center but any attempt to extricate itself will cause it to be torn to pieces. At any rate such execution is better than allowing them to run around wild; see Fig. 3.

Who said lemon squeezer? One need never to be afraid of using this one illustrated in Fig. 4, and the winner of the fourth prize is C. G. McKee, of Nashville, Tennessee. This lemon squeezer has a razor blade mounted in its lower jaw, so that in one operation it cuts the lemon in half, and squeezes it. It is not necessary to use a lemon compass with this device. Oh yes, you want to know what a lemon compass is, eh? Well, it is one of those new contrivances which tells you which way the lemon is going to squirt when you cut into it.

Altho we made no mention of Honorable Mentions, we are describing in a few words some of the thousands which were entered in this contest. The first Honorable Mention goes to George Croston of La Grande, Washington, for a model and sketch of a razor blade balance. Old Durham razor blades are used at the center and the balance is mounted upon a glass ink bottle. Two tapered wooden blocks assist in the regulating features and adjusting nuts mounted upon screws further regulate the balance. These screws incidentally act as the locking features of the center pivoted razor blade. The pans are likewise mounted upon razor blades.

Why not make some cutters for mother so that she can cut the dough for cookies. Fig. 6 shows how this is done and the second honorable mention is won by George Solkover. He is also a Washington man.

Even manufacturers entered the contest and from C. H. Fontaine of Paris, we get a hair cutter and comb combination. This is the third honorable mention and is illustrated in Fig. 7.

The fourth honorable mention, Fig. 8, is a spoke-shaver made of metal, no name accompanies the device.

A similar article which is awarded fifth honorable mention, is a drawing knife, Fig. 9. This is contributed by Herman A. Griffith, of Reading, Pa.

A very clever detector is the one submitted by John J. Van Horn, of Charleston, Washington. This is depicted in Fig. 10, and Mr. Van Horn is awarded the sixth honorable mention.

The design in Fig. 11 is an envelope opener. This consists of a moving member, the bottom of which is arranged so as to hold a series of razor blades in alignment with each other. Samuel Hagerman of Michigan, wins thereby the seventh honorable mention.

The paper cutter made from a knitting needle in Fig. 12 is awarded the eighth honorable mention.

The ninth honorable mention goes to Richard Heuer of Florida. In one operation this device creases the backing paper on a picture frame and cuts it off a suitable distance back from the edge.

The razor blade pencil sharpener, a manufacturers' article, wins the tenth honorable mention. It is shown in Fig. 14, and is submitted by the American Razor Blade Sharpener Co., of New York City.

The combination ruler, letter opener, pencil sharpener, and column cutter, which will remove one column from a newspaper in one operation, is shown in Fig. 15. This is awarded eleventh honorable mention, and H. D. Plumb, of Orange, N. J., is the lucky man.

A very clever device is shown at Fig. 16, altho for general utility and as a popular razor blade article it would not meet with very great favor, perhaps. This device shaves a thin piece of rubber from rubber covered adding machine or other rolls. It is awarded the twelfth honorable mention.

A thread cutter made from a small bit of a razor blade soldered into a thimble, shown in Fig. 17, is the work of Edward J. Witt, of Lancaster, N. Y. He wins the thirteenth honorable mention.

W. C. Michel, of Jersey City, N. J., submits a flower and stem shears, depicted in Fig. 18, and wins thereby the fourteenth honorable mention.

In Fig. 19 we see a fruit picker, a razor blade being mounted at the end of a stick and a tin can nailed to it. It is submitted by Harold Fraulob, of Los Angeles, Cal., who wins the fifteenth honorable mention.

The sixteenth honorable mention is the masterpiece of culinary art, submitted by Edward Hughes, of Wellington, Ohio. This is a cabbage or sauerkraut cutter, shown in Fig. 20.

George Solkover again wins an honorable mention, this time the seventeenth, by submitting a paper or insulation tape cutter, shown in Fig. 21.

A wire insulation remover is shown in Fig. 22. This is contributed by E. C. Lenz, of Chicago, Ill., who wins thereby the eighteenth honorable mention.

The variable condenser depicted in Fig. 23, wins the nineteenth honorable mention. This is contributed by "C. W."

(Continued on page 765)

"Skipping Boat" Contest Notice

IN OUR OCTOBER NUMBER, WE OFFERED $50.00 IN PRIZES—ONE OF $25.00, ONE OF $15.00, AND A THIRD PRIZE OF $10.00 TO THE ONE WHO CONSTRUCTED THE BEST MODEL OF THE "SKIPPING BOAT" DESCRIBED BY THE EDITOR IN THAT ISSUE. THE BUILDER OF THE MODEL WAS ALSO TO WRITE A SHORT ESSAY OF 200 WORDS OR LESS, EXPLAINING WHY THIS CRAFT WOULD OR WOULD NOT SKIP AS ITS DESIGNER HAD INTENDED.

WE HAVE BEEN ASTONISHED INDEED AT THE FACT THAT ONLY TWO LETTERS WERE RECEIVED, NEITHER OF WHICH GAVE ANY REASONS WHATEVER AS TO WHY THE CRAFT WOULD SKIP OR NOT SKIP. ONE OF THE LETTERS WAS ACCOMPANIED BY A MODEL OPERATED BY CLOCK-WORK. THIS IS MIGHTY EASY MONEY FOR SOMEBODY WHO WILL SIT DOWN AND DO SOME "REAL THINKING."

WE HAVE, THEREFORE, ADVANCED THE CLOSING DATE OF THIS CONTEST FROM NOVEMBER 20TH TO JANUARY 20TH, 1922. REMEMBER, THAT YOU HAVE THE LIBERTY OF REDESIGNING THIS SKIPPING BOAT SO THAT IT WILL ACTUALLY SKIP, BUT DON'T SEND A MODEL AND AN ESSAY, AS ONE READER DID, OF A MODEL HYDROPLANE OR SEAPLANE, WITH A PROPELLER AT THE FRONT TO PULL OR PUSH IT ALONG ON ITS PONTOONS. IF WE HAD WANTED A MODEL OF A SEAPLANE BUILT, WE WOULD HAVE SAID SO. SO WE BELIEVE YOU FULLY UNDERSTAND JUST WHAT WE WANT. HERE'S WISHING YOU LUCK—*THE EDITORS.*

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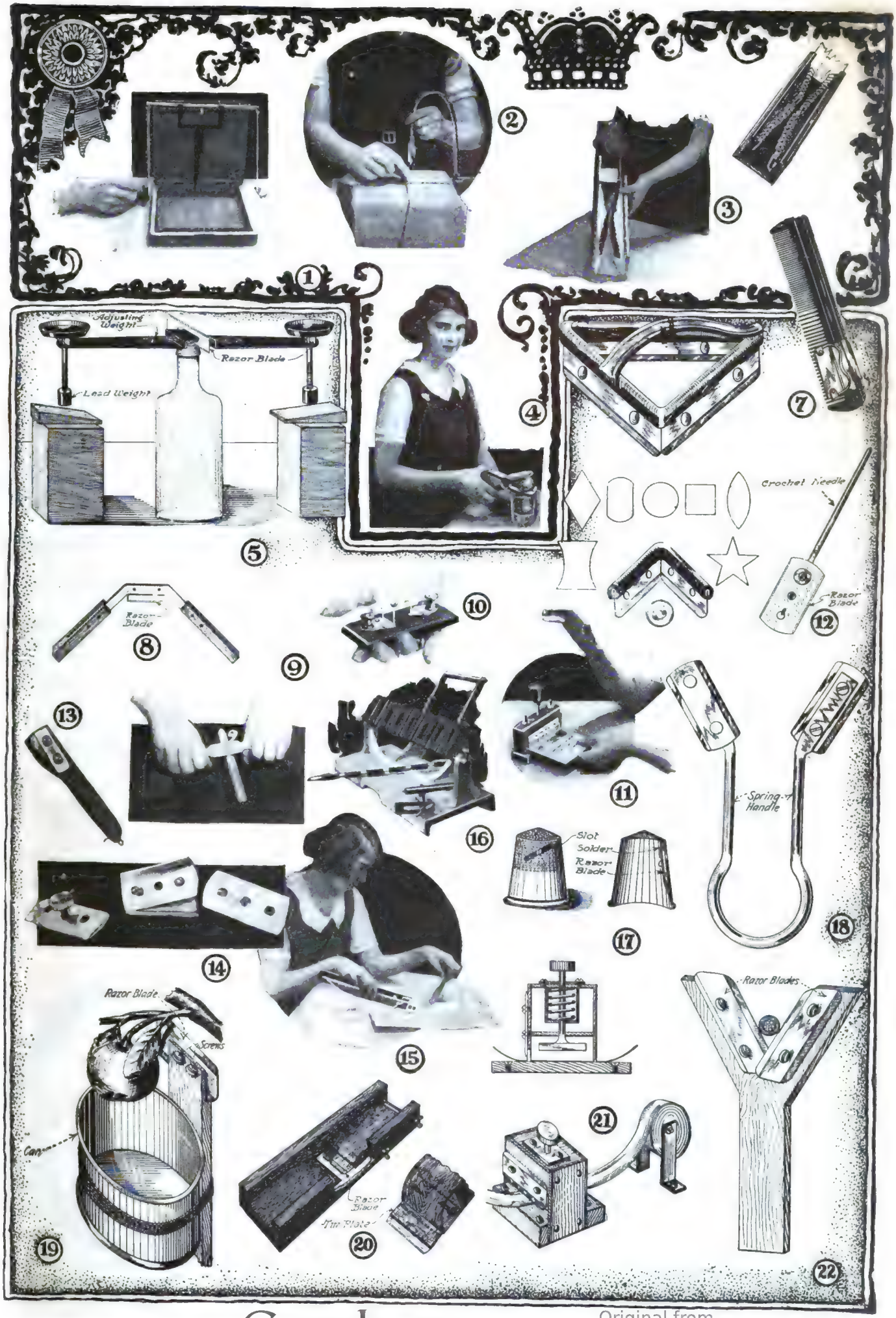

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MOTOR HINTS

First Prize, $25.00

UNPICKABLE IGNITION LOCK

The switch itself is assembled in a fiber or bakelite case about 3½" x 2¼" x 1½". There are two sets of contact springs EE open one circuit and close another. These contact springs are normally in contact with each other, but when the fibre arm F is turned between them, contact is broken.

The arm F is kept in position by the steel lock plate G, which has two upward projecting lugs, one on either side and two screws passing

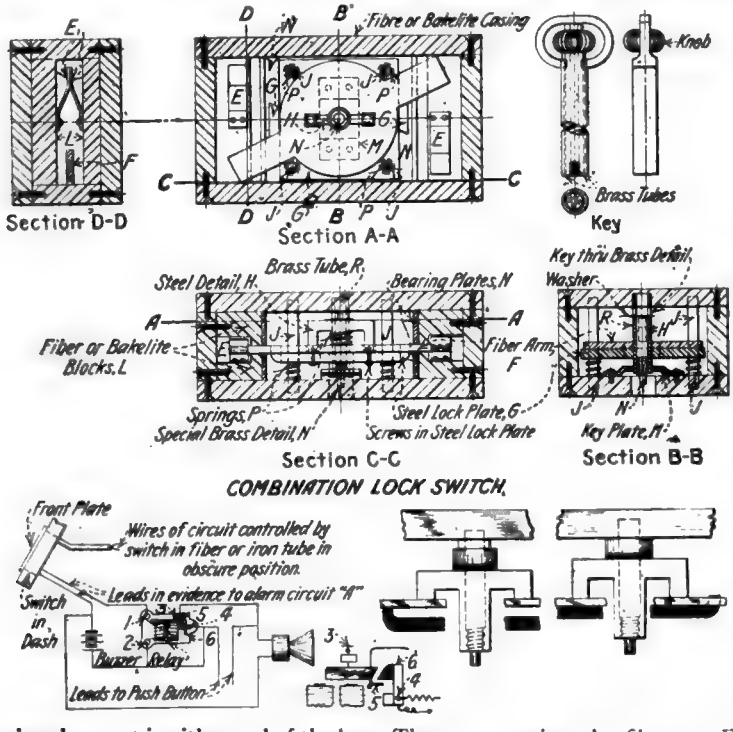
An Auto Thief May Pick the Lock on Your Car if It Is Operated With a Standard Key, of no Matter What Type. Mr. Broome Has Devised, We Believe, One of the Cleverest Locks Imaginable. Note That When Lock Plate G Moves Forward, That the Two Screws Disengage F, the Latter Sliding or Rotating Past the Screws.

alongside and thru holes in arm F respectively. Plate G is held in place by four screws J and four springs P forcing it up against the fibre arm F. Thru the center of plate G is drilled a hole to pass the special steel detail H. As this detail has a small lug on either side, there must be slots cut in the sides of the hole thru the plate G. A special brass detail N, made of round rod and threaded on the lower end, passes thru the hole in H. The upper end of N is held in place in a brass tube R. There are slots cut in R to take the pin thru N, the pin being soldered in a slot cut in the top of N. A washer separates R from H, the two being held together by a spring P pressing against F. The key plate M is fastened just inside of the key hole, being used as a bearing plate for the key. The hole drilled in this plate is similar to the one thru G with the exception that the slots are cut so they will pass and not engage the lugs of H.

The key consists of two tubes, one inside of the other and the inner one tapt to take the thread on N. The other tube has two slots to engage the lugs on H. When the key is inserted in the key hole against M, the slots in the outer tube engage the lugs on H, but cannot turn it since H is held by its lugs thru G. The inner tube is turned, pulling down N which in turn pulls down H, and the latter forces down G and disengages the holes in F. This leaves F free to turn by turning the outer tube of the key. The pin in the top of N prevents N from turning when the inner tube of the key is turned.

The circuit drawing is self-explanatory showing how the Klaxon is operated and stays operated when the false leads to the switch are shorted—these leads are not electrically connected to the switch. The buzzer relay should be located in some out of the way place where it could not be found easily. The Klaxon will operate until the spring clip is moved by hand releasing the armature and breaking the contact.

Contributed by FRANK H. BROOME.



placed one set in either end of the box. They may control two circuits or be placed in series in one circuit or may be arranged to

Second Prize, $15.00

A FOUR DIAL COMBINATION LOCK

In this Combination Lock Switch, a sketch of which I am enclosing, a pieceof hard rubber, fiber, or similar material, 4⅝ x 1½ x 5/16 in. is used. To this are attached 4 brass disks (Fig. C), as shown in Fig. A. These disks are about ¾ in. in diameter and 1/16 in. thick.

A contact point (3), Fig. A, is mounted in the opening of each disk. These are also brass and come flush with the surface of the disk, and of course are insulated from them; the only means of contact being by the lever (1) Fig. A.

The levers are operated from the front of the switch by knobs (Fig. B). In the base of the knob, ten equally spaced holes are drilled as shown in Fig. D. A pin, actuated by a spring set in the switch base, as shown in Fig. B, engages these holes sufficiently to keep the knob in any desired position, but not so tight but what the knob may be readily turned in either direction.

The size of the contact points, and shape and size of the contact lever are such that there will be no contact unless the pin is in the proper hole in the knob; one hole either way being sufficient to break the contact.

Here is a sample setting:

First: Turn all knobs to right till the levers strike stop pins (2), Fig. A.

Second: Turn knob (f) five notches to left.

Third: Turn knob (g) two notches to left.

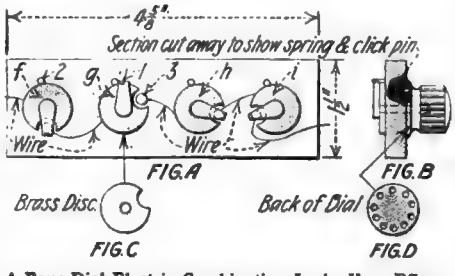
Fourth: Turn knob (h) three notches to left.

Fifth: Turn knob (i) seven notches to left.

The circuit is now closed, and it is only necessary to remember, the number 5,237.

The combination may be changed by moving the stop pins, or by changing the position of one or more disks.

Contributed by
LAWRENCE A. CLIFFORD.



A Four Dial Electric Combination Lock; Very Effective, but Not so "Unbeatable" as the First Prize Lock Above.

NOTICE—CONTRIBUTORS ! ! !

For the next few months we are going to give prizes only to such devices as prevent stealing of cars. It should be remembered always that motorists do not wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used.

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

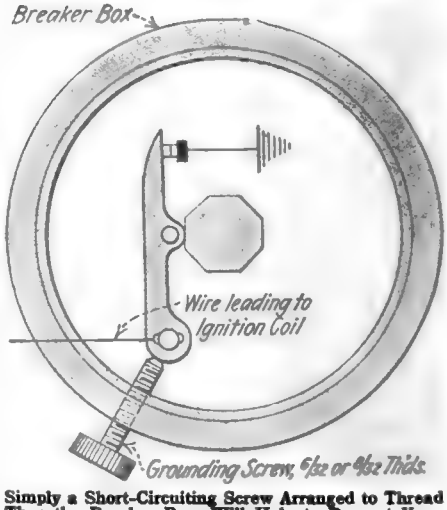
Third Prize, $10.00

SECRET BREAKER-BOX SWITCH

This idea may be used on battery as well as magneto equipt cars and consists of a grounding or short-circuiting screw, which prevents the circuit-breaker from functioning properly, altho mechanically there is no interference. This screw may easily be installed in any one of a hundred places.

I have a Berling magneto on my Overland car, with a housing over the brush holder, which latter collects current from the slip ring. I simply drilled a hole thru this housing to fit a small nail, which latter I insert whenever the car is left unattended.

Contributed by FRANK G. DU ROY.



Simply a Short-Circuiting Screw Arranged to Thread Thru the Breaker Box, Will Help to Prevent Your Car Being Stolen.

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Editor's Mail Bag

HAY FEVER

Editor SCIENCE AND INVENTION:

SCIENCE AND INVENTION and RADIO NEWS are read each month by myself and boys. I want to comment on the article in July SCIENCE AND INVENTION by Dr. Ernest Bade on "Hay Fever, its Causes and Cure," as I am a sufferer with thousands of others of the western country.

His description is absolutely correct, but his remedy does not appeal to us very strongly, as I believe it is as bad as the disease, punching needles into one at regular intervals.

I live at Topeka, Kansas, and never feel any effects at any time of the year from hay fever there, but west of Dodge City, Kansas, it is surely bad. Part of the day here, we are free, but suffer the most upon arising in the mornings with a terrible itching of the small piece of flesh which is seen in the inner corner of the eye and also roof of the mouth.

Probably the alkali in the dust aggravates it but, if so, why are we not bothered in winter?

We sincerely hope, he, or someone else will be able to give us relief.

M. O. DAVIS.

La Junta,
Colorado.

(The remedy for "Hay Fever" is not quite as bad as you think, altho "punching needles into one at regular intervals" as you state it, sounds ominous. It is scarcely felt.

I doubt if the alkali aggravates the Hay Fever; such aggravation is more likely to be due to excessive as well as periodically coming into intimate contact with the flowering, wind pollenated grasses in the fields.

The reason that you do not suffer during the winter is to be found in the simple reason that the flowering grasses, which do the greatest damage, flower only in early or late summer, depending upon the climate of the locality.

—EDITOR.)

OUR AMATEUR HUMORISTS!

Editor SCIENCE AND INVENTION:

Enclosed find my renewal to SCIENCE AND INVENTION for one year. I like the magazine very much, but I think you are making a mistake in keeping that amateur-humorists' page. It is out of place in such a journal, and the page could be used to better advantage. You say that you receive daily from one to two hundred contributions to that department, and only one or two are available. That page is too valuable for other uses to go to all that trouble of weeding out unavailable jokes for the few that you can use.

CHARLES J. THOMAS.

608 Cumber St.,
Cincinnati, O.

ANON THE SIMPLE STEREOSCOPE

Editor SCIENCE AND INVENTION:

This morning I made my customary visit to the local News Stand and purchased my September number of SCIENCE AND INVENTION.

It is with much interest that I read the article of criticism *re* the "Simple Stereoscope."

I wish to state that I have, in my course of study, covered

Physiological Optics
Practical Optics
Theoretic Optics
Physiological Optometry
Practical Optometry
Theoretic Optometry

and that I most heartily agree with Dr. Bade.

Mr. Wyckoff makes the statement that "Stereoscopic effect can not be produced by monocular vision, a fact that doubtless was realized by the CREATOR when in HIS infinite wisdom HE gave us TWO EYES instead of ONE." Perhaps Brother Wyckoff's knowledge is only limited to OPTICS as far as his camera, if so, there is a great amount to be learned by him, if he wishes to criticize *OPTICS in all of its branches*.

All that I ask is for Mr. Wyckoff to look up a *good* Opthalmic Dictionary, and tell me what he finds under the following heads: BINOCULAR VISION, SINGLE BINOCULAR VISION, MONOCULAR VISION, and DIPLOPIA in all of its forms. Also I wish Mr. Wyckoff to combine all of the above forms with the *true* definition of a STEREOSCOPE and see if he hasn't overlooked a few OPTICAL phenomena.

I will be ready at any time to back up Dr. E. Bade's article if Mr. Wyckoff sees his way clear to argue his point to completion.

D. A. RIGON.

Warsaw, Indiana.

WE invite our readers to use these columns for discussion on all subjects of interest to them. We aim to make this page an exchange place for ideas and invite discussion. As hundreds of letters are received weekly, it is manifestly impossible to publish all of them, and we aim to publish only the more interesting ones. Try to keep your communication within two hundred words, and use only one side of the paper when writing. It is not possible to answer communications address to this department by mail due to the great influx of communications received.

—EDITOR.

FROM SWEDEN

Editor SCIENCE AND INVENTION:

I enjoy the reading of your magazine very much and I think it has been improved a great deal since you changed its name. Now it is written so that everybody can understand it. I hate those "dry" science articles.

Articles like De Quer's and other scientific stories and such as "Leonardo da Vinci" by T. O'Conor Sloane are excellent. Please let us have more of Prof. T. O'Conor Sloane, and less radio.

By the way, many of your articles including "The Human Aura" and "The X-Ray Movie" have been translated into Swedish and are copied quite often by one of our Swedish magazines, that is a specialist in copying from others.

I hope the "copying magazine" will read this.

GEORGE HAMMER

Motala, Sweden.

WHY HE LIKES IT

Editor SCIENCE AND INVENTION:

In commenting on SCIENCE AND INVENTION, I would like to say that too many of us are knocking, instead of boosting it.

(*Continued on page* 770)

To Our Readers

THE publishers of SCIENCE AND INVENTION have decided to put the contents of this magazine to a popular vote by its readers. This magazine is publisht and edited *solely for our readers*, and we are more than anxious to give them exactly what they desire. You will have observed lately in this department, that some readers have a preference, others a dislike for certain articles and departments. For that reason, we thought it best to put the matter to a popular vote, and let the majority decide. You will readily understand that it makes no difference to the editors and publishers what matter is printed as we can have no preferences in the matter. The readers must be satisfied *first!*

We hope every reader will see it as his duty to fill in the adjoining voting blank, and send it to the editor. One cent is the total cost, as the blank can be cut out and pasted on the back of a postal card. In case you do not wish to mutilate the magazine, just copy the blank on a postal card and mail.

The editors pledge themselves to abide by the result which will be publisht as soon as a sufficient number of votes are in. We want to publish the results in the February issue, so get out that pencil.

EDITOR.

Voting Blank

MY VOTE as to the contents of SCIENCE AND INVENTION appears in this ballot. I have placed a cross in the blank spaces showing either my preference or dislike of the various subjects enumerated.

Name .....

Address .....

More	X	Less		General Department (First 32 Pages)
More	X	Less		Editorials
More	X	Less		"Rotogravure Section"
More	X	Less		"Editor's Mail Bag"
More		Less		"Home Mechanics"
More	X	Less		"Motor Hints"
More		Less	X	"Practical Chemical Experiments"
More		Less		"The Constructor"
More		Less	X	"How to Make It"
More		Less	X	"Wrinkles, Recipes and Formulas"
More		Less	X	"Radio Department"
More		Less	X	"What to Invent"
More	X	Less		"Latest Patents"
More	X	Less		"Scientific Humor"
More	X	Less		"The Oracle"
More	X	Less		"Book Review"
More		Less		"Patent Advice"
Yes		No		The magazine is all right as it is

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Home Electrics

By G. L. HOADLEY, M.E.

LOCATING "SHORT CIRCUITS" AND "GROUNDS"

INSTRUCTIONS were given in an earlier article on the methods ordinarily followed to restore service to house lighting circuits when the fuse blows. An overload is the cause of the blown fuse in many cases, and it is certain that the ordinary housewife can restore service herself by following the simple directions there stated. Quite often, however, the two wires of the same circuit get together, producing what is termed a *short;* or, the positive lead may get in contact with the earth, producing what is called a *ground*. Then, it is necessary to locate the trouble and remove it to restore the service, because a new fuse, if used to replace the blown one, will itself be blown as soon as the switch is closed, unless the trouble is first found and removed.

to the time that the actual *short* develops and blows the fuse. The reason is that not all the current is passing thru the iron. Part goes across thru some of the broken strands, and not enough current flows to heat up the iron sufficiently to iron properly. When such an event occurs, have the flexible cord repaired, and save $1.00 or more—the price of a new cord.

Repairing the cord is a simple matter and can be done by the housewife, if necessary. Simply cut off the cord far enough back from the heated end to remove the brittle wires—usually 4 to 6 inches is sufficient—as shown in figures. Then remove the insulation from the ends of the wires as shown in Fig. 2, being careful to pass the knife blade into the insulation almost parallel to the insulation covering,

cases is, of course, to remove the charred or burnt ends and attach the new bared ends of the wires underneath the binding-screws in the cap of the screw plug. *Shorts* sometimes result from allowing water to soak into the flexible cord used with the washing machine. Water should not be allowed to come in contact with any flexible cords or electrical fittings, as it tends to deteriorate the insulation, and shocks due to *grounds* can be easily obtained from almost any lamp socket or other electrical fitting, if the hands are wet, or if the fitting itself is wet and the person is standing on the ground or on the cement basement floor at the time.

In the wiring of the house itself *shorts* occur occasionally. *Grounds*, however, are more common than *shorts* in house wiring.

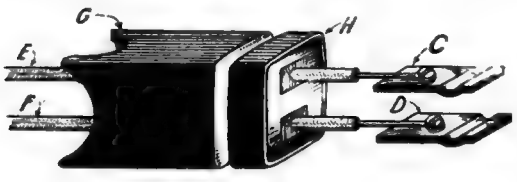


Fig. 3

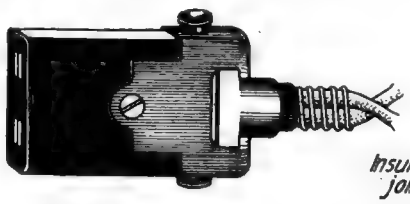


Fig. 4

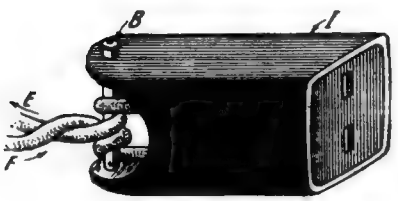


Fig. 1

Fig. 5

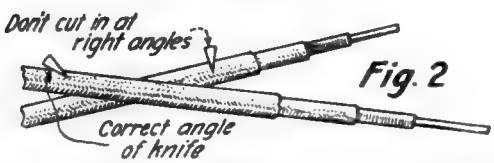
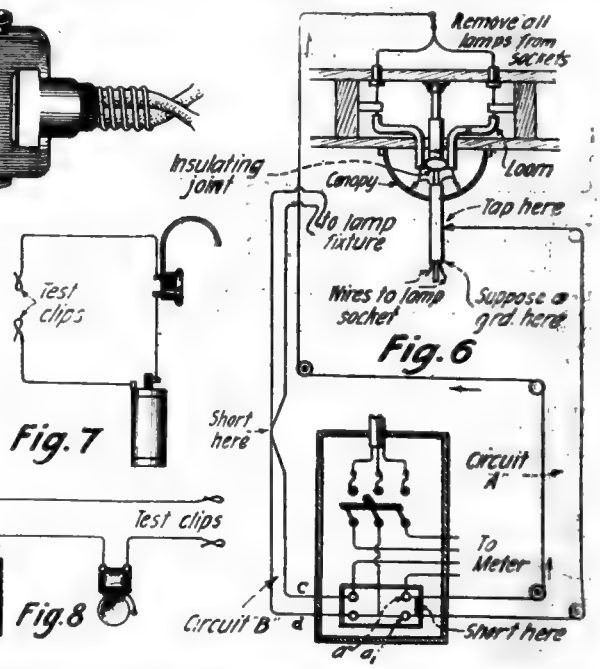


Fig. 2



The Diagrams Above Show How to Locate a Blown Fuse and Also the Apparatus Used for Testing Out Circuits to Chandeliers. Oftentimes a Grounded Circuit Is the Cause of a Blown Fuse and the Method to Follow in Testing for Such a Grounded Fixture or Circuit, Is Described by Prof. Hoadley so that Anyone, After Reading This Article, Will be Able to Find Out Where the Trouble Lies. One of the Main Things to Learn With Regard to the Replacement of Blown Fuses Is to Have a Supply of New Fuse Plugs on Hand, Say Half a Dozen of Each Size Used In Your Service Cabinet. It is Foolish to Place Pennies Behind Plugs or to Use Heavy Fuse Wire to Temporarily Repair the Circuit, as This May Cause a Lot of Other Trouble, Such as Burning Out Lamps, Motors, Etc.

Let us consider for a few minutes a few of the more probable causes of *shorts* and *grounds*. Take as an example, first, your electric iron. The flexible wire leads which connect your iron to the lamp socket get quite hot at the portion close to the iron from the heat of the iron. Heat deteriorates the rubber insulation which covers the wires and makes the wires brittle; the constant movement of the iron in its to and fro motion bends the wires back and forth until the outer small flexible strands which go to make up the wire break one by one down next the iron where they are most brittle, somewhat as shown in Fig. 1 at E. An arc forms then between the broken wire ends whenever the iron is used. This arc, in turn, burns and chars the insulation around the broken ends, making it an easy matter for the sharp points to pierce the insulation and touch the broken ends of the other wire as becomes evident. Current then flows directly across between the two wires as shown in the figure, and as the path is so much shorter and easier than thru the heating coils of the iron, a heavy current flows thru it and your fuse blows. That is a very common cause of a *short*. Mrs. Housewife will usually notice that her iron fails to heat properly several times previous

instead of at right angles to the covering, so that the wire will not be nicked. Next, remove bolt B from the plug, Fig. 1, and pull the inner porcelain fittings, together with the wires, out of the metal shell as shown in Fig. 3. Loosen terminal screws C and D, take out and cut off useless wires E and F. Then take the two bared ends of the good wires, Fig. 2, and insert them into the porcelain fittings G and H, Fig. 3, and fasten them to the terminal screws C and D as shown. Slip on the outer metal cover I, Fig. 1, wrap the wires with one turn around the wooden or fiber cross-piece holder and fasten it in place with the bolt B, as shown in Fig. 1. The newest pattern has two protecting steel coils, one inside the other, and a swivel (see Fig. 4), which effectually prevents the breaking of the wire strands for a much longer period of time.

Shorts between wires sometimes occur in the screw-plug ends of your flexible cords leading to the electric sewing machine, vacuum sweeper, toaster, etc., as shown in Fig. 5. The wires are very close together here and after repeated pulls on the cord the wires are apt to loosen and come out from under the binding-screws, thus getting in contact with each other and blowing the fuses. The remedy in such

Combination fixtures for lighting which supply both gas and electricity are sometimes installed without insulation joints. Then *grounds* may be a more frequent source of trouble, as the bare wires can easily come in contact with the gas pipe or fixture metal, allowing the current to flow direct to ground. A brass or metal socket should not be used in basements or bathrooms unless it is beyond the reach of anyone standing either on the cement floor or the ground or high enough to be out of reach of anyone touching the bath-tub or a faucet. Porcelain or a moulded composition socket should be used in such places to avoid possible injury due to defective socket-insulation. In spite of recent improvements in sockets, the turning on and off of a key socket will in time be likely to wear away the socket so its shell becomes *alive*, and any person touching a *live* socket shell will receive a more or less severe shock, depending on whether the person is standing on earth or cement or on the grounded bath-tub and whether the hand touching the socket is wet or dry. The reason is that current flows directly from the live socket thru the person to ground, and thence back to the power house.

(*Continued on page 773*)

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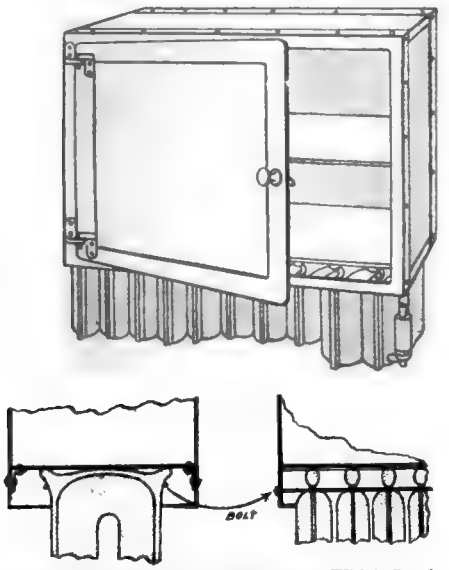
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

HEATING OVEN FOR RADIATOR

A lot of valuable heat is going to waste in the ordinary dining room radiator that can be put to good use heating our food, dishes, etc. We give a practical illustration of how this waste heat can be used. Here

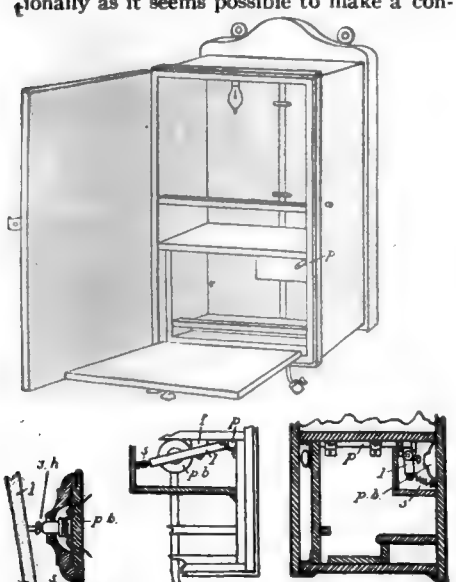


Here Is a Most Useful Heating Oven Which Can be Fitted on Top of Any Radiator. It Is Constructed from Black Sheet Iron and Is Attached in the Manner Shown, so That It Cannot be Knocked Off or Upset. The Two Long Iron Bolts Serve to Lock It in Place on the Radiator.

we have a metal oven attached securely to the radiator. It is constructed in a durable manner, and attached in such a way that it cannot be tipt over or knocked off—it is as firmly fixt as the radiator itself—yet it can be removed almost instantly. Two long iron rod-like bolts do this trick. The oven will give additional heating surface to the radiator and thereby increase the effectual warmth received from the steam supply in the room as well as warm food and dishes.

SAFETY MEDICINE CABINET

In the illustration we show a medicine cabinet that is as safe against taking out harmless or poisonous medicines unintentionally as it seems possible to make a con-



A Safety Medicine Cabinet Fitted With an Automatically Operated Electric Light Which Flashes When the Lower Compartment Door Is Opened, This Compartment Being Used for Poisonous Medicines. By Having the Two Doors and Electric Light Reminder, There Is Slight Chance of Anyone Taking a Poison Bottle from the Cabinet Unknowingly.

tainer of this sort. The cabinet consists of two parts, each having a door; the upper and larger part is for the harmless varieties of home remedies, the lower for the poisonous varieties. This arrangement makes it necessary to open two doors to get at the poisonous kinds and, as an extra precaution, we provide an automatic electric light danger signal, that is operated by the opening of the second door. The cabinet is the same as any ordinary variety of this useful household accessory, with the poison cabinet built in at the bottom—the door of the poison cabinet when open being useful as a shelf.

The automatic lighting arrangement (red bulb) consists first of a plunger, P, supported in one corner by loosely fitting straps as shown; second a lever I, suspended to an inclined fulcrum F, and controlled by a coiled spring S; and third any common push button P. B., suitable for the transmission of current to a lamp, either from a storage battery or the usual public service supply. A 4½ watt bulb, using a very light current, is large enough. It will be seen that this mechanism will close the circuit when the door is opened, by allowing the spring S, to pull the lower end, or its attached screw head S. H., against the plunger of the push button P. B., as shown; or that when the door is closed the plunger P, which was pushed out by the spring S moving the lever I as before described, will reverse the operation and move the screw head S. H. away from the push button P. B., and by these means shut off the current.

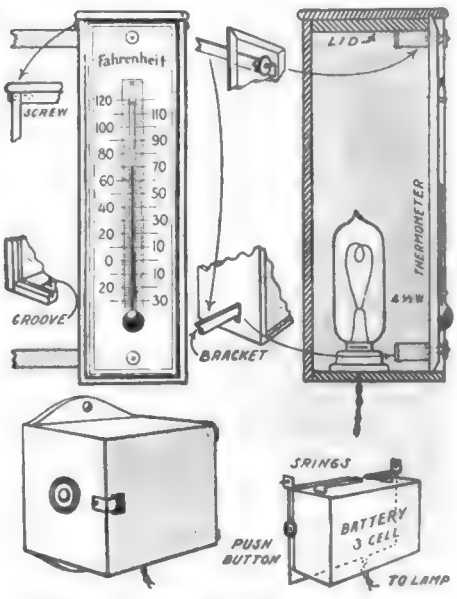
THERMOMETER LAMP

A thermometer lamp is shown in the illustration attached to an out-of-door glass scale thermometer of the common type. The lamp consists of two parts as shown, but can be made of but one part if the public current supply is used, instead of a storage battery. The lamp is a 4½ watt bulb of any desired pattern inclosed in a light weight box. This box is like an ordinary oblong wooden box, commonly used by druggists for holding powders, with the exception that one end (the top) is provided with a lid held in place by screws entering its lower part from each side and from the bottom. The thermometer takes the place of the wooden sliding lid in the ordinary box and enters the grooves made for it in the box in the same manner. It will be seen that when the box and thermometer are thus put together, a weather and water-proof inclosure is provided for the lamp. The inside of this container is painted with white enamel paint which forms a reflector on all five surfaces; the outside is painted with a black water-proof paint having a glossy surface. The thermometer brackets of course protrude thru holes made for them in one side of the lamp box.

The lamp is operated from within doors—the wires being brought thru a hole bored in the window or door frame for this purpose—either from an ordinary switch, or a push button attached to a three cell battery box arranged and constructed about as we have shown in our illustration.

DOOR-SWING, BAR AND TRAPEZE

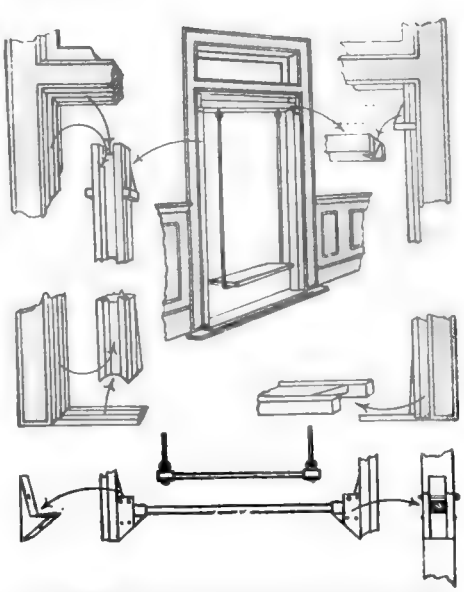
A frame that can be attached to any convenient door or removed in an instant, without using nails, screws, or anything that will mar the paint or woodwork of the door, is shown in the illustration. This frame can be used to suspend a swing, trapeze or hold a horizontal bar. It is formed of four pieces that lock together making a safe support for either of the three appliances. There are two side pieces grooved to fit over the sill and jambs, as shown, both at the top, bottom and sides. It will be seen that these pieces can be put in place one on each side of the door opening and be securely held by the door jambs and sill. To hold these firmly in place a cross-piece at the top, sufficiently heavy to support a swing or trapeze, is provided having beveled slots that attach wedge-fashion on the side pieces, as shown.



A Valuable Household Wrinkle Which Will Render It Easy to Read the Thermometer Scale Outside the Window at Night. The Electric Lamp Used to Illuminate the Glass Thermometer from Behind May be a Small One Operated from a Battery of a Few Dry Cells, or It May be Lighted from the Usual 110 Volt Lighting Current.

Another cross-piece, operating in the same manner, but of thinner material is used at the bottom; this piece is made so as to fit over the sill, and thus insure against any danger of its being loosened or being kicked away by the feet.

The horizontal bar used in the attachment herewith may very well be constructed, when convenience dictates, from a piece of iron pipe about 1" in diameter.



The Collapsible Wooden Frame Shown Above Provides at Once a Door-swing, Horizontal Bar and a Trapeze. The Novelty of This Device Lies in the Fact That It Can be Put in Place or Removed Quickly Without Marring the Woodwork of the Door in the Least. It Is Also Very Strong, Owing to the Ingenious Way in Which the Various Parts are Cut and Fitted Together

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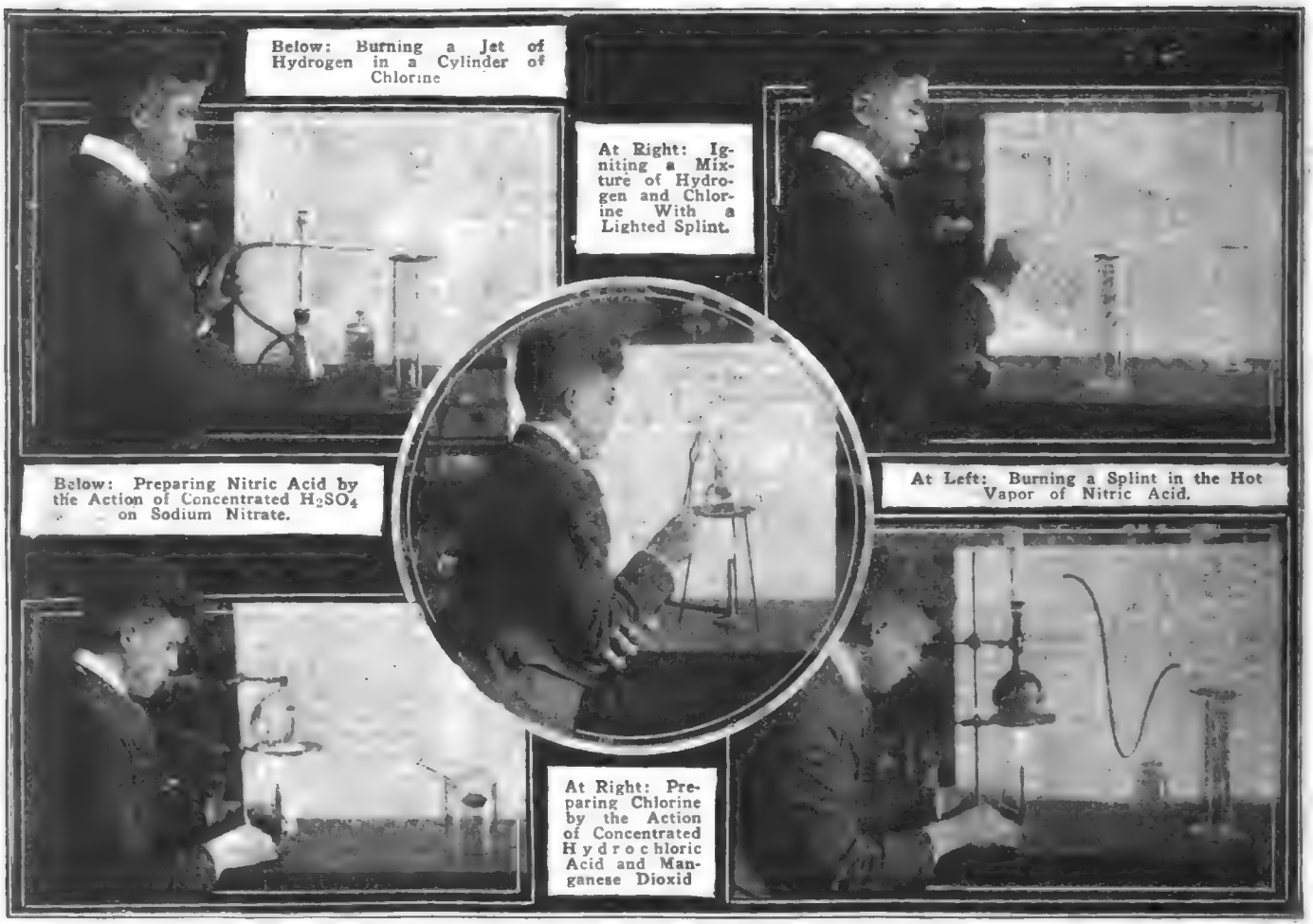
Practical Chemical Experiments

By PROF. FLOYD L. DARROW

PREPARATION OF ACIDS


Below: Burning a Jet of Hydrogen in a Cylinder of Chlorine
At Right: Igniting a Mixture of Hydrogen and Chlorine With a Lighted Splint.
Below: Preparing Nitric Acid by the Action of Concentrated H_2SO_4 on Sodium Nitrate.
At Left: Burning a Splint in the Hot Vapor of Nitric Acid.
At Right: Preparing Chlorine by the Action of Concentrated Hydrochloric Acid and Manganese Dioxid

THE compounds of inorganic chemistry may be divided into three fundamental classes, namely, acids, salts and bases. By stating the chemical character of a compound we mean to indicate to which of these groups it belongs. And practically every mineral compound may be placed in one of them. Altho some compounds such as certain oxides may not be acids or bases themselves, yet with water they will form either an acid or a base. And this is the difference, too, between a metal and a non-metal. An element, whose oxid with water forms a base, is a metal, and one whose oxid with water forms an acid is a non-metal. Sodium is a metal while sulfur is a non-metal.

Now in this and one or two succeeding articles we shall consider in some detail these three classes of compounds. In the present article we shall deal with acids—their preparation and properties.

Hydrochloric Acid: The old name for this acid is *muriatic acid* and you still frequently see this name applied to it, especially in drug stores. As its name indicates, it consists of two elements, hydrogen and chlorine. Both of the constituent elements are gases, as is also the compound product. Hydrochloric acid, as it is used, is not, as is commonly supposed, a liquid but a gas in solution, and it is the second most soluble gas known to science.

Its synthesis by direct union of the elements may be carried out in two ways. In one a jet of hydrogen is quietly burned in a bottle of chlorine, while in the other the two gases are mixt and ignited; they then unite with explosive violence.

In order to obtain the necessary chlorine, set up apparatus as shown in Figure 1, and place in the flask a small quantity of manganese dioxid. Set the apparatus under a hood or in a good draft. Pour upon the manganese dioxid enough concentrated hydrochloric acid to cover it well. Then warm gently and collect two cylinders of the gas by upward displacement of air, that is, the gas goes down and the air goes up. You can tell when the cylinder is full by the green color of the gas. When full cover the cylinders with glass plates. *Be very careful not to breathe any of the escaping chlorine gas as it is exceedingly poisonous.*

Now set up a hydrogen generator in the usual way and using zinc and dilute sulfuric acid collect two cylinders of hydrogen gas over water. Then immediately ignite the gas from the delivery tube of the hydrogen generator and thrust it into one of the cylinders of chlorine. Instead of going out the flame continues to burn with a lavender color and forms hydrochloric acid gas, which fumes as it escapes into the air. (See Figure 2.) When all of the chlorine has combined with hydrogen the flame will be extinguished. Incidentally this experiment shows that combustion can occur without the presence of oxygen.

The *explosion of hydrogen and chlorine* to form hydrochloric acid can be carried out safely as follows: Covering a cylinder of hydrogen with a glass plate bring it mouth downward over a cylinder of chlorine. Remove the plates between the cylinders and shake them for a few moments to mix the gases. Then stand them upright on the table and quickly ignite with a long wax taper. (See Figure 3.) A very vigorous explosion results and the cylinders are left filled with hydrochloric acid gas. Immediately cover them and invert in a basin of water. Upon removing the glass plates the water will rise in the cylinders, showing the great solubility of this gas. If the water has been colored blue with litmus it will turn red as it rises in the cylinder.

(*Do not attempt to carry out this experiment with the gases in a confined space, as they unite with dangerous violence.*)

The usual preparation of hydrochloric acid is from the action of sulfuric acid upon its most common salt, sodium chlorid. Using apparatus exactly similar to that employed in the preparation of chlorine place in the flask two or three tablespoonfuls of ordinary table salt and cover well with sulfuric acid

(*Continued on page 760*)

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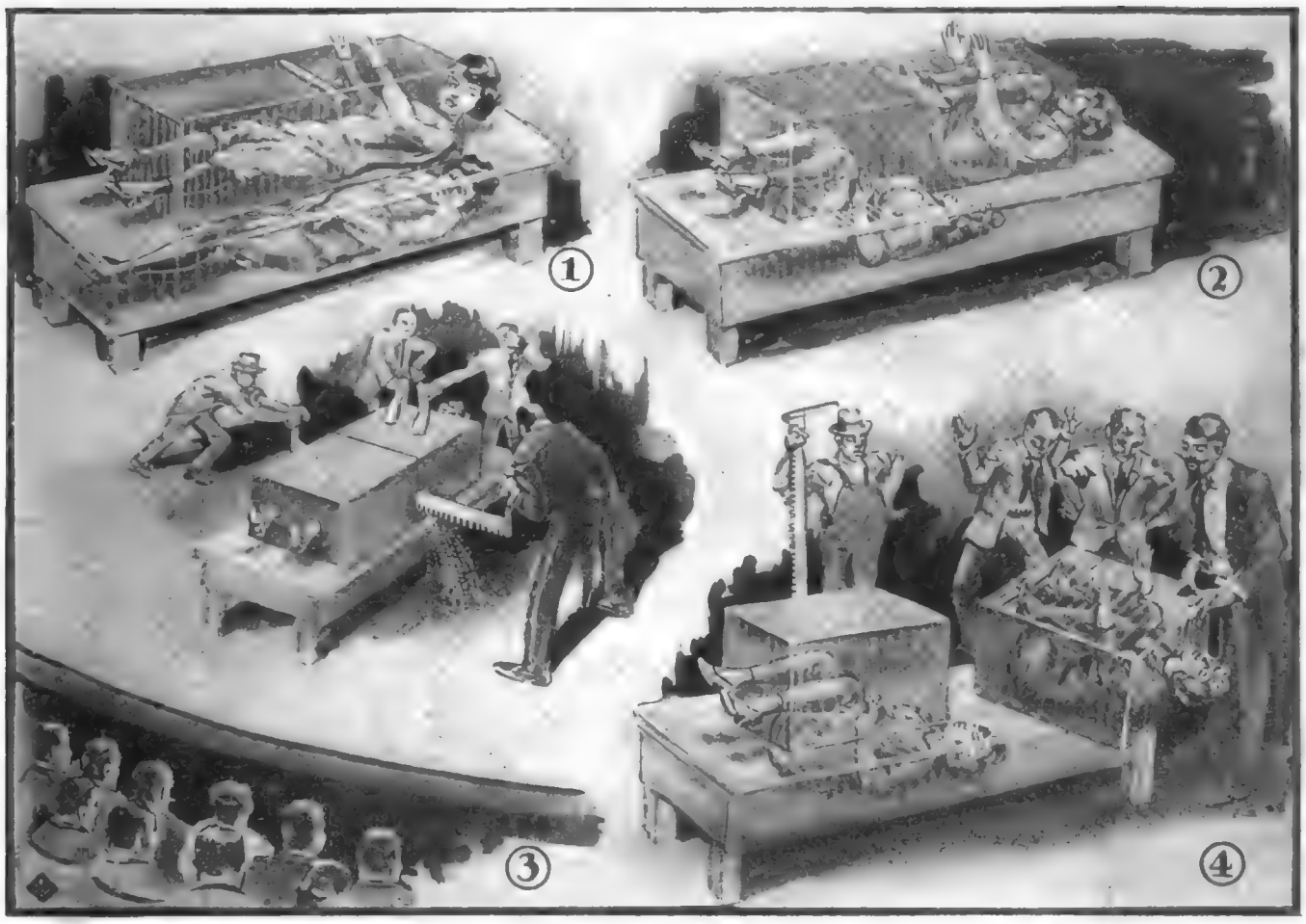
Sawing a Person in Half

By A. HAZELTON RICE, Jr.



One of the Most Mysterious Acts Which Can be Produced Either for Semi-Professional or Amateur Theatricals, Is the Trick Here Illustrated—of Sawing a Person in Half. As the Illustrations Indicate, Two Young Women are Necessary in Producing this Illusion and the Large Table Used Must Have a Hollow Top of Sufficient Depth to Accommodate One of Them. The Illustrations, Together with the Detailed Description Given in the Article Below, Will Render Perfectly Clear the Successive Phases of This Magic Act.

THE cold-blooded dismembering of a young and otherwise very attractive young woman for no other purpose than the delectation of an audience of amusement seekers can be easily imagined as occurring in the arenas of ancient Rome, but it is well nigh impossible to describe one's impressions upon witnessing such a feat on the modern vaudeville stage.

The surgeon extraordinaire appears before the curtain is raised, explaining that he is about to saw his lady assistant completely in two and that the operation, while a very delicate one, is performed absolutely without pain. Then, as tho to put his audience at ease, he adds that she will be promptly restored to her normal condition, after the operation, and that she has consented to the experiment without coercion.

After thus enlightening his audience, the arch-vivisectionist turns to the rising curtain and greets the victim, a charming little miss, who instantly makes you resent the perpetration of any such villainous assault upon her anatomy as is contemplated.

The performer calls for assistants from the audience and after selecting two and seating them upon the stage he turns to the victim, suddenly holding before her eyes a small crystal ball. And now a secret—gentle and unsophisticated reader—the effect of this act is much greater on the audience than upon the subject. No,

A Mystifying Trick That Is Not so Magical as It Appears

I do not mean, as I have sometimes heard it said, that the entire audience is hypnotized and consequently sees things that it does not see, but for some unknown reason hypnotism and magic seem to have linked themselves inseparably, and it is, therefore, entirely befitting that she should be placed in a comatose condition before proceeding further. Having been thoroly satisfied that the subject is under the hypnotic spell, the audience is willing to believe almost anything possible. In other words, a *mystic atmosphere is created.*

The victim is then laid upon a table; two straps are lowered from the flies or above-stage, and after being securely fastened, she is raised a few feet in the air to make room for the cabinet into which she is to be placed.

"Aha!" says my reader, "the Hindu sword and basket trick again!" but wait.

The victim is lowered into the cabinet, which is a bit short, her head and arms protruding from one end and her feet from the other. The two ends of the cabinet are placed in position, these latter having semicircular openings for the neck, hands and feet. The cabinet and table are then swung around a quarter turn so that the cover may be closed and locked in full view of the audience and its committee of two. This accomplished, the cabinet and table are swung back into their original position. One of the committee is assigned to the holding of a dainty pair of ankles at the foot of the cabinet and the less fortunate one vice versa.

The saw, about the capabilities of which there can be no doubt, is brought upon the stage and examined, and then, amidst goose flesh music by the orchestra, the cabinet, and incidentally its occupant, are cleanly severed while the audience holds its breath and shudders.

A slide is then placed in each section of the cabinet, thus mercifully sparing the audience from an inspection of the debris, and the two sections are pulled apart in order that the performer may walk between them and show that there is no deception. Two window curtains of the proper size may be used to close the cabinet compartment, operating them by strings, etc. Upon placing the sections of the cabinet together again and unlocking the cover, the young lady, much to the relief of the audience, arises none the worse for her experience.

The inventor of this illusion, as are all followers of magic, is a true disciple of Barnum, and of his doctrine that the public likes to be fooled, and in this he has certainly succeeded.

(Continued on page 770)

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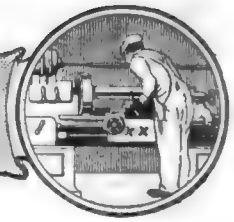
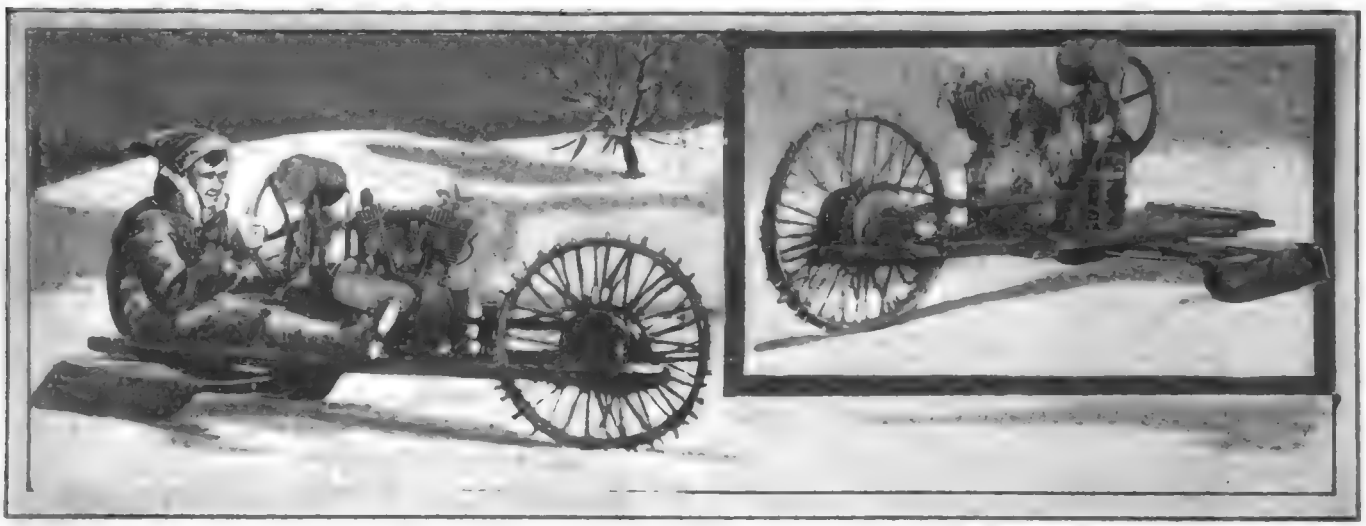
THE CONSTRUCTOR



Ice Boats and Speeders

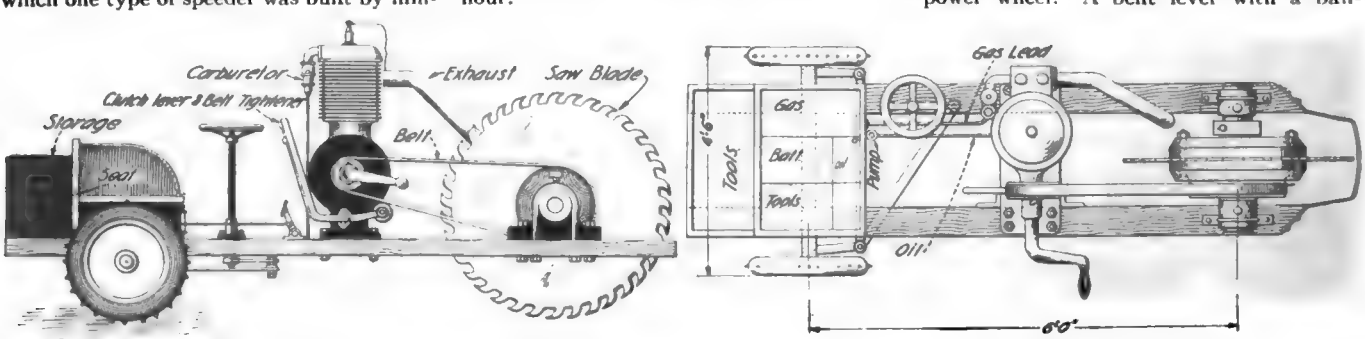


There Is Probably no Greater Sport for the Winter Months Than Ice "Boating." In the Accompanying Drawings and Text General Directions are Given for the Building of Both Small and Large Ice Boats. A Small Ice Speeder With Gasoline Engine Drive Is Shown in the Drawings Below, as Well as in the Photos Above. An Old Circular Saw Blade Makes a Very Good Traction Drive Wheel for the Ice Speeder, and Where This Is Not Available a Substantial Wooden Wheel May be Used, Providing the Perifery Is Fitted With a Series of Iron Spikes.

NOW that the winter is almost upon us, the question of what sports are to engage us during the dreary bleak winter days is foremost in our minds. Of course there is sleighing, skating, skiing, and toboganning, but the finest sport of all without a doubt is *ice boating* and *speeding*. With the instructions given here, ice boats or speeders can easily be constructed. Bill Caley has contributed two photos of his ice speeder which show clearly the mechanical lines upon which one type of speeder was built by himself and his partner. He had an old 1915 motor-cycle and removed its engine and placed it in the speeder, and many of its other parts were used to great advantage. The rear wheel of the motor-cycle was mounted so that it could be used as the drive wheel of the sled and was placed up in front. To this wheel the engine was directly connected by means of a chain and never-slip horseshoe calks were riveted to an iron rim, which was subsequently placed over the wheel. This furnished the necessary traction. The engine was then mounted upon the frame, which is but 7 ft. long, and the clutch upon the engine was so arranged that it may be thrown in or out as desired. The brake to the wheel is of course placed so as to be easily accessible. Runners are mounted in the rear and pivotly arranged, steering being accomplisht thru their aid. Under very adverse conditions, in which the ice was covered with two to four inches of snow, this sled actually made 60 miles an hour.

Mr. P. P. Avery gives the following details for constructing an ice speeder and also an ice boat. He says that the following two devices can be easily constructed and will be valuable to anyone located near a body of water which freezes over in the winter time.

First, make a frame of 3" x 4" wood strongly bolted together. A good 6 or 7 horse-power air cooled motor-cycle motor is clamped to this frame. Then procure a 1½ inch rawhide belt which has been fully stretched. This will be used to drive the power wheel. A bent lever with a ball-bearing idler wheel releases the slack of this belt when it is desired to maneuver slowly, and when the idler wheel is so adjusted that all the slack of the belt is taken up and consequently no slippage is obtained, practically the full power of the motor is delivered to the power wheel. Altho the carburetor and the oiler of the motor-cycle are not changed, the gasoline tank and the oil tank are both equipt so that air pressure may be



The Two Diagrams Above Show a Side and Top View of an Attractive Little Ice Speeder. It Is Driven by a Motor-cycle Engine and It Will Travel Over the Ice at a Great Rate of Speed, Up to 60 Miles an Hour and Better.

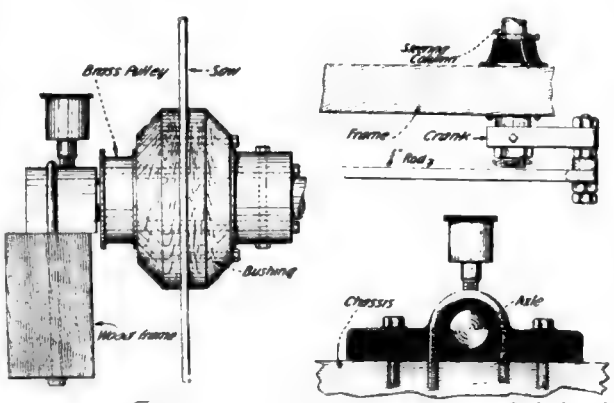


Diagram at the Left Includes Details of Mr. P. P. Avery's Ice Speeder, Provided With a Circular Saw as the Power Wheel Which Propels the Craft Over the Ice. The Cost of Building Such an Ice Speeder is Insignificant Compared to the Pleasure One May Derive.

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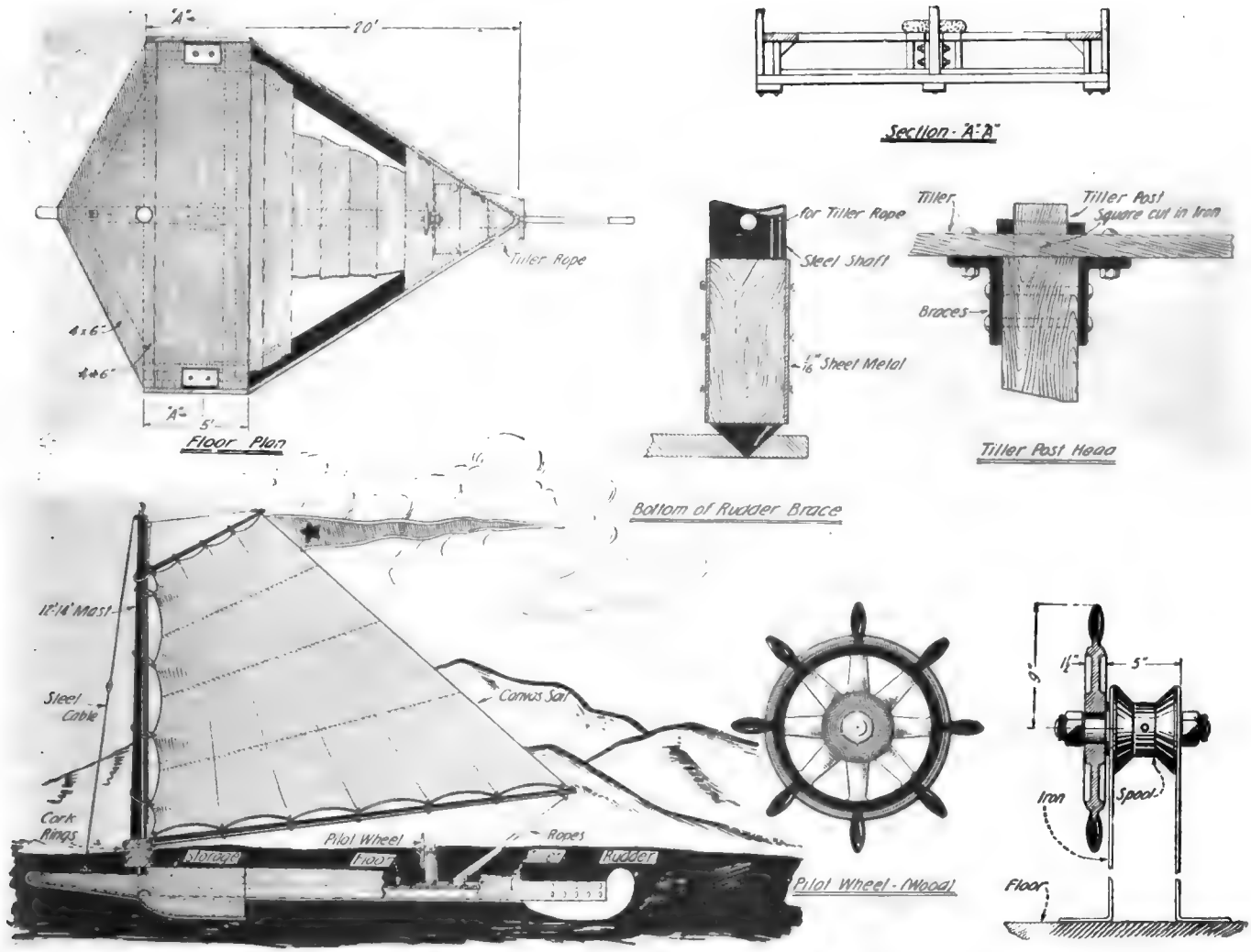

Probably the Greatest Sport in All Ice Boating is to be Found in the Handling of the Swiftly Moving Sail-Propelled Craft Here Shown, as Reproduced from the Drawings of Mr. P. P. Avery, M.E. It Has Been Said That Aside from the Airplane, the Swiftest Moving Craft in the World is Undoubtedly the Ice Boat, Which Has Established a Speed Record of Over Two Miles a Minute. The Mast of the Ice Boat Should be Well Stayed in Position from Either Side, as Well as at the Front, Using Turnbuckles to Pull the Cables or Ropes Taut. Those Desiring a Smaller Craft Than the One Shown, Will Gain Some Good Ideas from This Article as to the Steering Arrangement, and They Will be Surprised at the Speed Obtainable Even With a Small Sail When There is a Good Wind Blowing. One Feature of the Ice Boat is That There is no Gasoline to Buy.

applied if desired. The same magneto is used for ignition which is usually found on these motor-cycle engines, but because of the extremely cold weather at times, it is desirable to insert a separate battery system for easy starting. The driving wheel consists of a 36 inch circular saw blade which may be obtained from any second-hand machinery dealer. Holes are drilled thru this to hold the axle, wood hub and bearings in place. The gasoline and oil tanks, as well as the battery and coil, can be placed under the seat, and wires leading to the spark plugs should be run thru metal conduits. A word in regard to the steering; this is simply accomplisht by means of a 1 inch rod and plate connected to an arm which connects with the regular type of front axle cut to fit. A 14 inch steering wheel is preferably employed, to which are attached the necessary controls for spark and gas. The brakes are drums of wood fastened to the wheel spokes and fitted with the usual brake lining. The brake action is fitted under the floor with a pedal protruding and connected to the brake proper by means of a flexible steel cable. The entire floor is then covered with 4" x 1" yellow pine, and over this, along the edges, molding is rigidly fastened to give it a neat and finished appearance. By following the diagram closely and by using a little ingenuity, the reader can develop a very successful machine capable of driving him across the ice lickety-cut at a speed of from 45 to 70 miles an hour. In starting the motor, it is most desirable to retard the spark control and just give the motor a little gas. The clutch is thrown out so that the belt is quite loose; the brakes are applied and a small stone is placed under the driving wheel for safety. A crank is then slipt over the motor shaft and after a few smart twists, the engine will start off. The crank is now removed and the spark advanced, but the gas is kept low and the engine is allowed to run until it idles nicely. The stone may now be kicked away and the clutch lever slowly pulled in until the entire contrivance starts to move. The gas is thrown in fuller when needed.

The ice boat is a little easier to construct. First procure a board of spruce and cut this as illustrated and bolt the pieces together. Then make two side runners and fasten them together, first bracing them with 3/16" sheet iron. Now purchase a mast and step this in place with the necessary fittings running a 1/4" steel cable from the top of the mast down to a screw eye in the bows, with a turnbuckle conveniently located in the middle of this cable to allow for taking up of any slack. The rudder is firmly set in collars, and a tiller made of a piece of 3/8" x 2" wood is secured to the rudder. Cords are run thru pulleys all along the sides of the craft up to the steering wheel shaft, so that it is not necessary to use the wheel when steering the craft. This cord enables the rider to steer it regardless of his position upon the craft. The frame is now strongly criss-crost with pine and cross wires with their necessary turn-buckles may be inserted to make the entire boat more rigid. The floor is then covered with 1 inch yellow pine. Great care must be exercised in the setting of the sail and a good quality of duck is a very serviceable cloth to make the sail from. Any type of halyard or any number of pulleys may be employed for hoisting the sail in position, dependent entirely on its size. The shape of this boat makes it possible for riders to quickly shift their position and great speed may be attained.

In the smaller crafts a tiller is preferred instead of a wheel. Under the circumstances the tiller would have to be arranged so that it will line up with the rudder. The addition of a tiller makes it easier to maneuver the craft. Of course the mast should be suitably guyed by stays; three are quite enough and each should be equipt with a turnbuckle so that the stays and shrouds may be tightened at will.

The rings holding the sail in place should be numerous, more than are show in our illustration of course, and the sail must in all events be very carefully fitted, otherwise it will bag and much of the energy imparted to it by the wind will be lost. The closer the sail comes to being a flat board surface, the better the sailing qualities of the craft will be. Whenever it is found that the sail is rather difficult to stretch to its fullest extent, several pulleys may be inserted at either end so as to allow the rope to pass back and forth four or five times. This permits of sufficient traction upon the rope to hoist the sail to its fullest extent without appreciable effort on the part of the pilot. No brake is required in this boat, in that in order to stop the vessel its nose is turned into the wind or else the sails can be suddenly released. Speeds as high as a mile a minute are rather common with this type of craft and much better records have been attained in races.

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Compressed Air-Driven Model Monoplane

How to Build and Fly the Machine

By WILLIAM J. BEACH

MODEL airplane construction undoubtedly ranks preëminent as a mechanical hobby, as it is scientific, instructional and full of action. What could be more gratifying than to see a miniature 'plane before you, its highly polished little cylinders glistening in the sunlight and to know that it is only a matter of turning the tiny air cock when the pistons will reciprocate and impart motion to the propeller. Away goes your handicraft scampering over the ground, the next instant to be in the air and behaving like one of its larger prototypes. In constructing a model plane provided with a miniature motor, reduction of weight must be uppermost in the builder's mind—the model about to be described herewith should not exceed one and three-quarter pounds and every ounce or part thereof, that you can reduce below this minimum weight, will add materially to the flying efficiency.

The air-tank or container is the first job to start on, and this should be made very carefully from the thinnest phosphor bronze procurable, which is, roughly speaking, about as thick as the paper from which you are reading. Two domed end caps are procured from some metal spinner's shop. These should be 5" in diameter. A wooden mandrel or roller is made to fit the inside of the caps less the thickness of the sheet bronze which you wind spirally around the mandrel, allowing a ¾" lap, which you solder on the outside while still on the mandrel. The sheet bronze has now become a tube which is removed from the mandrel and the spiral lap carefully soldered on the inside. Now saw the mandrel down the center from end to end and replace one-half in the tube for the purpose of a backing while you drill a series of small holes ¾" apart in the center of the spiral lap thruout its entire length. These holes should be the size of a small brass escutcheon pin, one of which you place in each hole, cut to length and rivet, allowing the heads to be inside the tube; when riveting substitute a bar of round steel, for the half-round wood piece, which you used when boring the holes. As the riveting may have broken your soldering at some point, it is well to run the iron along the points again both inside and outside. Trim the ends of the tube so that they will fit the end caps neatly. Place the two halves of the mandrel back in the tubes, slip the end caps on, and drill a series of holes around the caps thru the tube ⅜" from the edge. These holes should be slightly staggered ¾" apart. Place and secure rivets in one end cap in a similar manner as described in the seam. Naturally you cannot rivet the opposite end as you cannot place your dolly against the rivet heads, due to both end caps now being in position, in which case you invert the rivets, allowing the heads to be on the outside so that they will not fall into the tank. You now solder the caps to the tank and sweat some solder around all rivets. The next procedure is to run a No. 30 drill thru the end of each cap, over one of which holes you solder an ordinary bicycle valve, removing the valve proper from the casing, while soldering the same, to prevent the heat from damaging the rubber.

A winding of the smallest steel piano wire is now placed around the tank and along same extending from cap to cap, the coils should be about ½" apart, each coil secured to the tank by wiping the soldering iron along the surface of the coils at three equal points around the periphery of the tank. The tank should have a total length of 18".

The tank is now ready to be connected to the motor, which is of the horizontal opposed type and made as follows: It has a ½" bore and ½" stroke. The crank case and motor supports are made from two pieces of sheet steel 1/16" thick. Do not use brass as it is liable to break when bending. Study Figs. 3 and 4 carefully, then make an exact drawing of same on the sheet steel, using a keen sharp scriber for the purpose. Center punch and scribe the circles, shown in Fig. 3. Having decided that the work is laid out correctly, cut same out roughly with a hacksaw, placing a piece of ½" birch board at the back of your work while secured in the vise; the introduction of the birch board will prevent your saw blade from being stript of its teeth and allow you to make a straight cut. Having Figs. 3 and 4 sawn out, finish to the lines with a file. The circles in Fig. 3 should be drilled under size and finished with suitable files, as an attempt to bore them accurately would mean a disappointment. Fig. 3 is now bent to right angles on the dotted lines A, while Fig. 4 is bent on the dotted lines B and C as is indicated and for the purpose clearly shown in Fig. 2. The parts having now been bent to shape, one is secured to the other by the tongue and slot method, which presents itself immediately the two parts are placed together. As you have been working with flat metal it is well to continue with same and make Figs. 8 and 11.

MODEL AIRPLANES OF MANY DIFFERENT TYPES AND SIZE HAVE BEEN DESCRIBED FROM TIME TO TIME, BUT WE BELIEVE THAT OUR READERS WILL FIND THE LARGE MODEL HERE ILLUSTRATED OF EXCEPTIONAL INTEREST. THIS MONOPLANE IS PROPELLED BY COMPREST AIR, AND THE AUTHOR OF THE ARTICLE HAS BEEN BUILDING SUCH MODEL AIRCRAFT FOR MANY YEARS, THE DATA HERE GIVEN HAVING BEEN OBTAINED FROM ACTUAL EXPERIENCE IN BUILDING SUCH MACHINES. THIS MONOPLANE WILL, IF PROPERLY BUILT, FLY FOR A DISTANCE OF 400 TO 500 FT. THE COMPREST AIR MOTOR AND TANK HERE DESCRIBED WILL BE FOUND USEFUL FOR DRIVING MANY OTHER MODELS, SUCH AS THOSE OF BOATS.

Fig. 8 is the crank arm, which is made from a piece of ⅛" flat steel having two ⅛" holes bored ¼" apart from center to center and shaped, as is shown. Fig. 11 is a connecting rod of which you require two; these are made from ½" flat brass. The drawing is self-explanatory and needs no further explanation. Fig. 6 is the valve sleeve and should be turned from a piece of cold rolled steel and carefully reamed to ¼" inside. The three No. 30 drill holes should be bored before reaming. Fig. 7 is also turned from cold rolled steel and finished a friction tight fit for the ¼" hole in Fig. 6. After the two 7/16" flats are filed on Fig. 7, which is the rotary valve and propeller shaft combined, it is very carefully lapt (ground) to a perfect fit in the valve sleeve or female part, Fig. 6. Now turn up Fig. 5, which is a collar to keep the valve from sliding back, and is held in position by the small set screw shown. Fig. 9 may be made, which is the crank pin, and together with Figs. 8, 7, 6 and 5 completes the valve, valve sleeve, valve collar crank and propeller shaft. Two flanged collars as shown in Fig. 12 may now be made. Two cylinders as per Fig. 13 are machined from cold rolled stock and slotted with a hacksaw, as shown The pistons, Fig. 10, are turned from aluminum and finisht to a perfect fit. To assemble the motor, the connecting rods are placed on the crank pin which is then riveted to the crank arm, the crank in its turn being riveted to the valve. The valve sleeve is soldered into the center of the crank case while the valve is secured with the collar. One flanged collar, Fig. 12, is now slipt on to the shaft and secured. Pistons and wrist pins having been placed on the connecting rods, are inserted in the cylinders which are soldered to the crank case. The back half of the crank case may now be attached and soldered to the nose of the tank. A small quantity of brass tubing the diameter of a No. 30 drill, is led from the hole already provided in the tank, to the air cock, from which point a U-shaped piece of pipe is brought into communication with the two front holes in the valve sleeve. A pipe to each cylinder head is led from each of the center pair of holes while the remaining two are left open.

The operation of the engine is as follows. As one piston reaches top center, one of the flats on the valve allows the air to flow to the piston, thus forcing it to the bottom of the stroke and exhaust take place thru the slot in the cylinder. In addition a secondary exhaust occurs on the upstroke due to the second flat on the valve, which allows any air that may not have escaped thru the cylinder part to be forced back thru the intake pipe into the valve and out again thru the third hole in the valve sleeve, which third hole is always closed on the power stroke.

The propeller employed on this motor, and suitable for propelling the plane about to be described, is 16" diameter and carved from a blank 1" thick; a ¼" hole is bored thru the hub to receive the shaft, to which it is secured by the two flanges, Fig. 12.

The body structure of this model is very simple, light, strong and easy to make. It consists of a single slab of wood, cut to simulate in profile the side of a speed 'plane. The forward end of the slab has its center cut away to receive the air tank, which is secured in position by the three aluminum bands, as clearly shown in the side view. It will be observed that provision is made for readily connecting the air pump hose to the valve at the rear of the tank. The rear of the body structure is reduced to a skeleton by cutting parts away, and leaving only top and bottom longerons and vertical struts. The extreme face end is slotted as in Fig. 4 to receive the horizontal stabilizer. The whole of this body member is covered with thin silk on each side, which materially strength-

(*Continued on page* 776)

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Compressed Air-Driven Model 'Plane

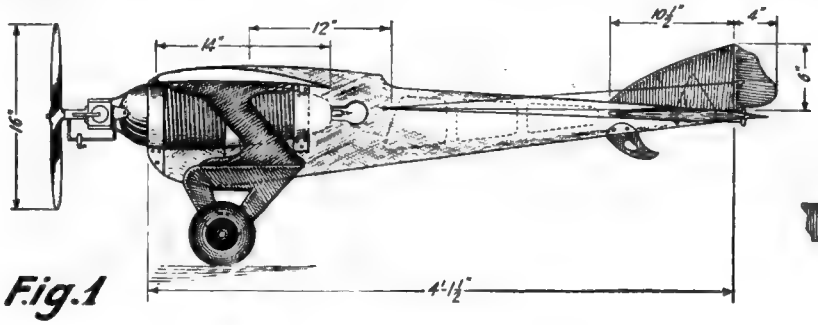

Fig. 1

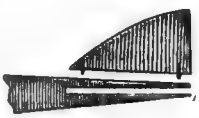

Fig. 4

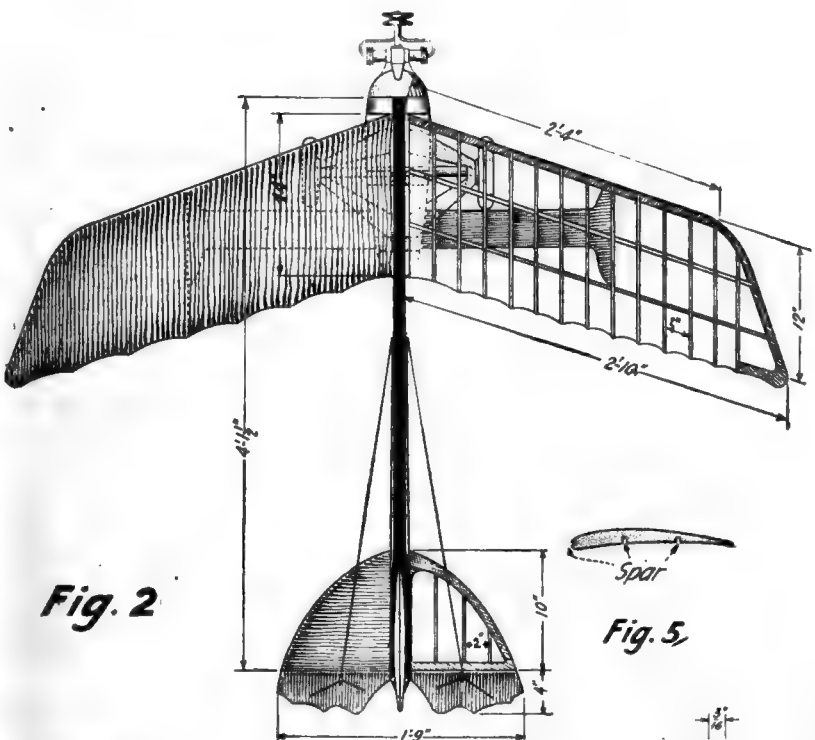

Fig. 2

Fig. 5

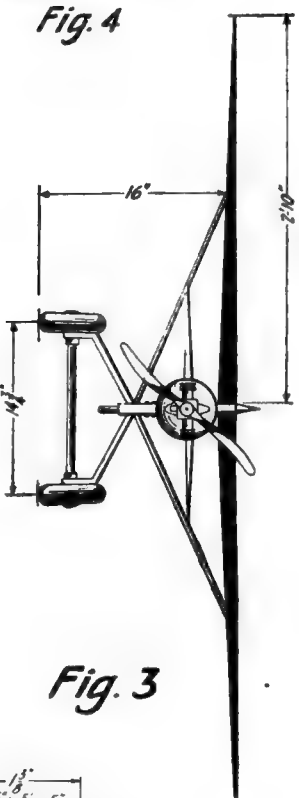

Fig. 3

Fig. 1

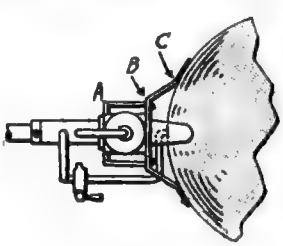

Fig. 2

Fig. 5

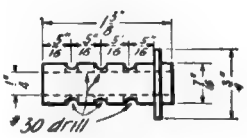

Fig. 6

Fig. 7

Fig. 8

Fig. 9

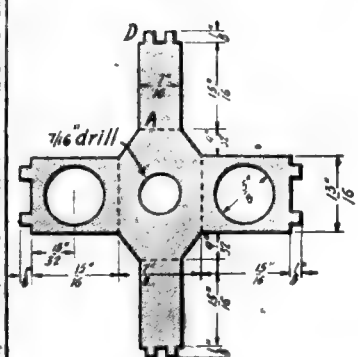

Fig. 3

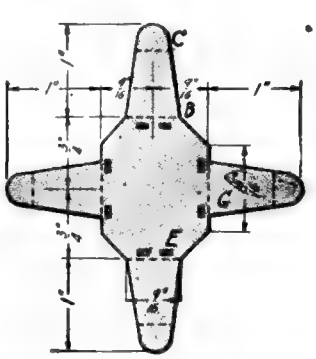

Fig. 4

Fig. 10

Fig. 11

Fig. 12

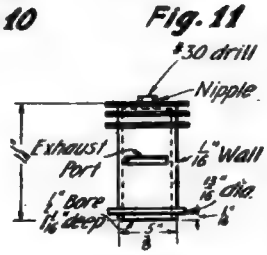

Fig. 13

The Compressed Air-Driven Monoplane Shown in Detail Above, Will Undoubtedly Prove of Great Interest to All Model Builders. This Model Flier Measures Over 4 Ft. in Length and About 4 Ft. in Width. It Is Fitted With a Specially Designed Compressed Air Motor, Details for Building Which are Given Herewith. It Is Operated by Compressed Air Stored Within the Metal Tank Mounted in the Fuselage of the Machine. This Tank Is Wound With Brass, Phosphor Bronze or Piano Wire to Strengthen It, as Shown in Fig. 1. The Landing Wheels of the Craft Should be Fitted With Rubber Tires, and Spring or Other Type Shock Absorbers May be Fitted by the Ambitious Model Builder.

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HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

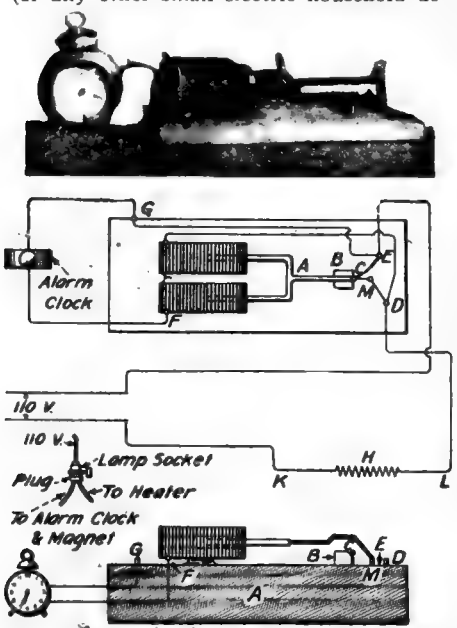
FIRST PRIZE, $5.00

TIME SWITCH FOR ELECTRIC HEATER

This is a sketch of my apparatus which I constructed out of an electro-magnet, a few screws and bolts and nuts for terminals, an old alarm clock and home-made copper knife switch made from broken switch block.

This apparatus is designed for the automatic control of a small bedroom heater. When one goes out in the evening to a theatre or elsewhere, it is ofttimes desired that the heater at home be turned on about a half to one hour before his return home. To leave the heater in operation from the time of departure would probably mean overheating of the room, and also an unnecessary consumption of current.

This little rig-up will switch on the heater (or any other small electric household de-



An Automatic Time Switch for Electric Heaters. Which, Thanks to the Alarm Clock, Can Be Set to Turn on the Heat at Any Predetermined Hour. A Pair of Small Electro-Magnets, Connected as Shown, do the Trick.

vice) during the absence of the owner, at any hour for which it may be set. Of course, it can also be used to turn on the heat on a chilly morning, say an hour before the usual rising time. It would thus comfortably heat the room while the person sleeps.

The electro-magnet is wound with fairly heavy wire and is put in series with the heating coil which will allow approximately about 5 or 6 amperes to pass thru the magnetizing coils. The alarm clock is in series with both the heater and the electro-magnet. One wire from terminal G is grounded on the back of the clock. The other wire (from terminal F) is set at right angles to the plane of the face of the clock, opposite the time desired for the heater to be switched on. The glass is removed from the clock, of course, to allow of this operation.

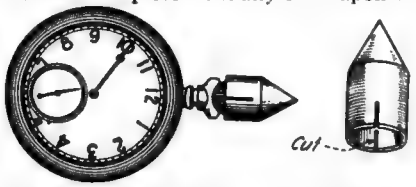
When the hour hand comes round (the minute hand being removed from the clock entirely) and makes electrical contact with

(*Continued on page 777*)

SECOND PRIZE, $3.00

REVOLUTION COUNTER

I desired a revolution counter for determining the speed of a motor and was at a loss at how to secure one without paying an exorbitant price. Finally I hit upon the



A Very Good Idea Indeed—a Speed Counter for Measuring the Revolutions per Minute of Motors and Other Machinery and Constructed from an Old Watch. It Can Be Carried in the Vest Pocket.

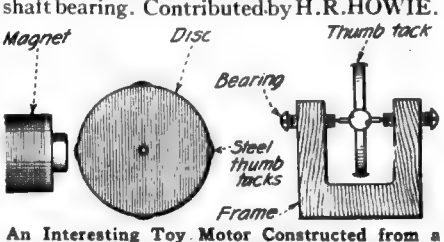
idea in looking thru my junk drawer, where I procured an old dollar watch, which had been dissected quite a long time ago, but still had sufficient "linings" within to permit performing this stunt. After removing the hour hand I attached a small brass sleeve as illustrated in the diagram, to the crown. Then I turned the crown, until I found out the number of turns in the crown, necessary for one complete turn of the hour hand. This figure being definitely known, it was only necessary to count the number of revolutions made by the hour hand and in timing it with an ordinary watch, I was able to discover the revolutions per minute made by the motor. I subsequently calibrated the dial so as to give the determination of the number of turns in various quarters. The particularly novel feature was that I could place the watch against the shaft, but no revolution took place, and upon a slight pressure, which engaged the gears within, I was able to start and stop counting, gaging the time interval by my watch. Contributed by M. E. MITTAL.

THUMB TACK MOTOR

Mount two or four steel thumb tacks, evenly spaced, on the edge of a thin wooden disc (a flat cork will do) two to three inches in diameter, and place in a V-shaped bearing frame.

Using A. C. from the lighting circuit it will only be necessary to bring the disc close enough to an electro-magnet and spin the disc until it gets in step with the current. One-half pound of No. 24 D. C. C. wire on a one-half inch iron core in series with a 60 watt lamp will do excellently.

Using dry cells, connect each tack with a piece of bare No. 24 wire and then to the shaft. Place a piece of wire or strip on the frame so as to touch the tacks as they revolve in series with the magnet, battery and shaft bearing. Contributed by H.R.HOWIE.



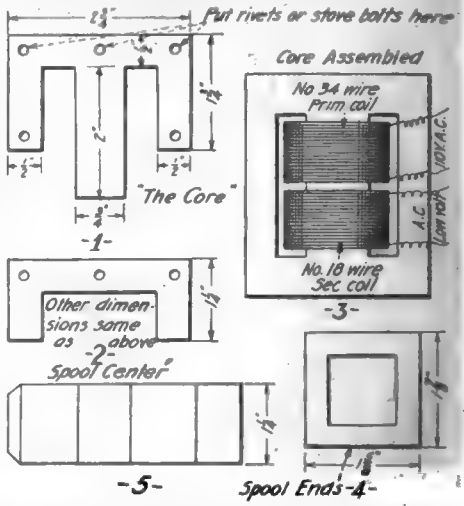
An Interesting Toy Motor Constructed from a Cork and Some Steel Thumb Tacks, Together with an Electro-Magnet Obtained from a Discarded Bell or Other Apparatus.

THIRD PRIZE, $2.00

LOW PRESSURE A. C. TRANSFORMER

This small transformer is well adapted to operate buzzers, small motors, etc. The secondary voltage ranges around four volts. The core I made from two *potential coil* cores from a discarded watthour meter core. If the reader is unable to procure a meter core, he will have to make the core from annealed sheet iron. Make a pile 15/16" thick of the shape shown in figure 1, the dimensions being given, and also a pile 15/16" thick of the shape shown in figure 2; and finally is assembled by lapping the laminations. If the directions are followed carefully this will make a very compact core, which is very essential in transformer construction.

The secondary coil was simply wound on a form, no spool being used, as I used cotton covered ribbon wire, about 3/32" wide and 3/32" thick. If ribbon wire is not handy use No. 16 or No. 18 D. C. C. magnet wire. Wind enough on the form to make a coil



Data Is Given Above for Building Your Own Step-Down A. C. Transformer for Reducing the Potential of the Electric Light Circuit to a Suitable Value for Operating Buzzers, Bells, Small Motors, Etc.

three-quarters of an inch wide and three-eighths thick, allowing for linen tape. Wrap lightly with linen tape and soak thoroly in shellac or some other insulating medium and bake until hard and dry.

The primary coil is wound on a cardboard spool, dimensions of which are given. Wind enough layers of No. 34 silk covered magnet wire to fill spool within one-eighth of an inch from outside edge. Then solder on your leads. To test for enough wire on primary Mr. J. W. Eshnaur's article on "Building and Testing Small Transformers" in the 1919 October number of this magazine, should be consulted, or it can be tested experimentally. When the coil has been completed, wrap tightly with linen tape or, better yet, cord, such as bricklayers use for levels. Soak in shellac or insulating varnish and bake.

As to the mounting, anything which suits the builder's fancy will do as long as it is durable; altho a case made of some hardwood would make the transformer look more respectable.

Contributed by HENRY HOLMES.

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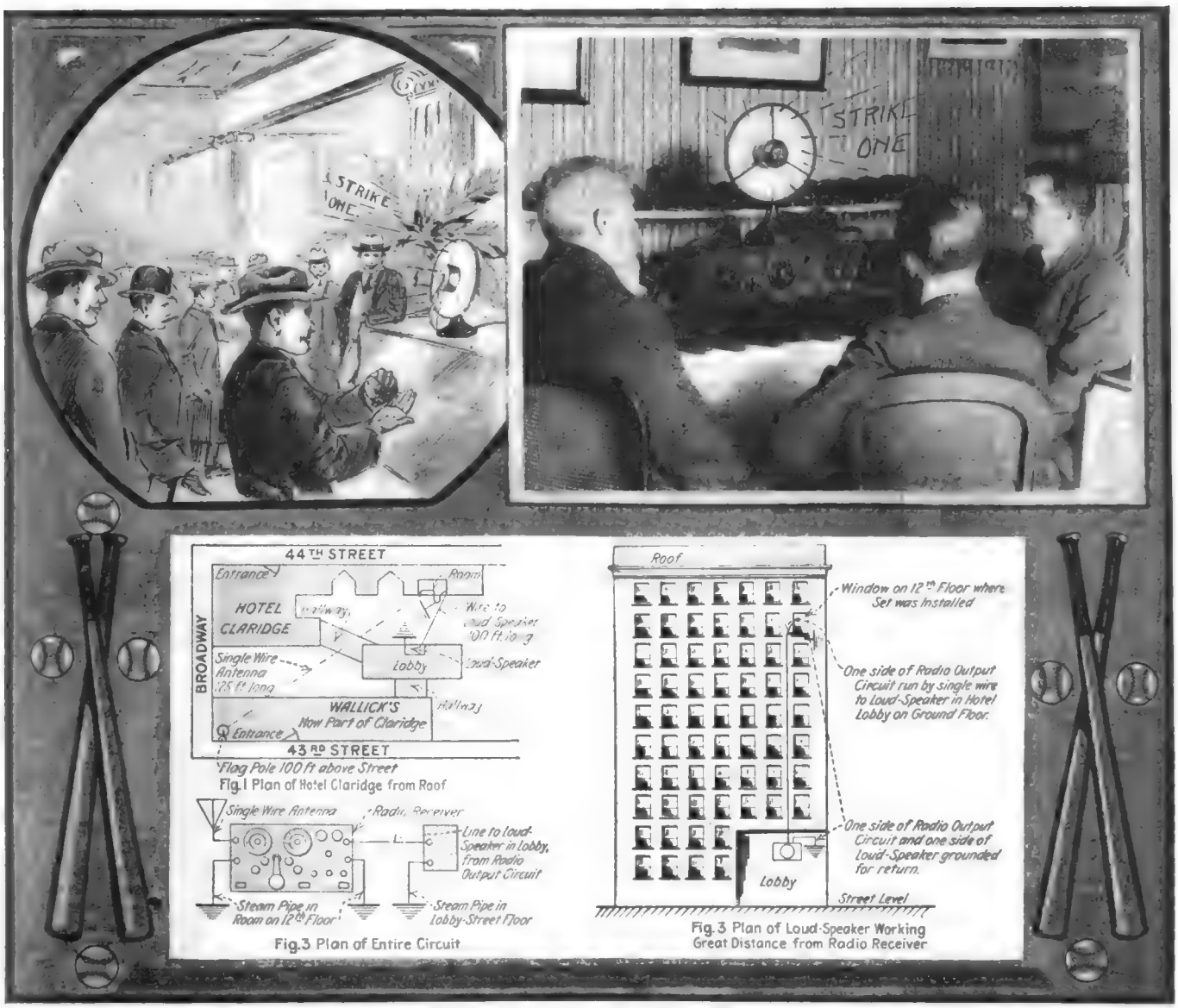
RADIO DEPARTMENT

The World's Series by Radiophone

By ARTHUR H. LYNCH


STRIKE ONE
STRIKE ONE
44TH STREET
Entrance
Room
HOTEL CLARIDGE
Hallway
Wire to Loud Speaker 100 Ft. long
BROADWAY
Single Wire Antenna 125 ft. long
Lobby
Loud-Speaker
WALLICK'S Now Part of Claridge
Hallway
Entrance
43RD STREET
Flag Pole 100 ft above Street
Fig. 1 Plan of Hotel Claridge from Roof
Single Wire Antenna
Radio Receiver
Line to Loud-Speaker in Lobby, from Radio Output Circuit
Steam Pipe in Room on 12th Floor
Steam Pipe in Lobby-Street Floor
Fig. 3 Plan of Entire Circuit
Roof
Window on 12th Floor where Set was Installed
One side of Radio Output Circuit run by single wire to Loud-Speaker in Hotel Lobby on Ground Floor.
One side of Radio Output Circuit and one side of Loud-Speaker grounded for return.
Lobby
Street Level
Fig. 3 Plan of Loud-Speaker Working Great Distance from Radio Receiver

A New York Hotel was Fitted Up With a Radiophone Loud Speaker in the Manner Here Shown in Detail, so That the Returns of the World's Baseball Series, Play by Play, Were Instantly Announced to the Guests in the Hotel Lobby. A Shoe Salesman Entertained a Number of Guests in His Room Each Day the Series Were Played, the Plays Being Heard Via Radiophone.

"THE game is over; the Giants are the World's Champions." That was the greeting which came to the ears of thousands of baseball fans, who could not attend the series in person, but were permitted to follow the eight games, play by play, because of the effort of the *Westinghouse* concern who operated a radiophone broadcasting station, in conjunction with the *Newark Sunday Call*.

Within a radius of several hundred miles from Newark, there were all sorts of gatherings about radio-receiving sets, where the news was being received. In a great many of the radio-supply houses, loud-speakers were installed and occasioned great interest. Many of the newspapers thruout the territory used the radio reports in conjunction with some sort of indicating boards, which were watched by thousands of interested people.

The writer installed a receiving set in his room at the Claridge Hotel, in New York City, and then ran wires to a loud speaker in the lobby. The loud speaker soon had to be taken out, for it was impossible to pass thru the lobby, due to the crowd, which would gather just as soon as the music from the Jersey station, which was sent out to give operators an opportunity to tune, started. However,

(*Continued on page* 782)

In December "Radio News"

A Simple Type of Radio Direction Finder for Use on Shipboard. By F. W. Dunmore.

Radio on a New York Newspaper. By Arthur H. Lynch.

C. W. Transformers. By Florian J. Fox.

A Highly Efficient Receiver. By Charles M. Srebioff.

"So This Is the Wireless." By Stanley Edgar.

Modulation Systems for C. W., Which Will Give Satisfaction in Your Station. By Arthur H. Lynch.

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A Short Wave Regenerative Set

By WILLIAM H. GRACE, Jr.

IT has come to the writer's attention thru articles appearing in Radio journals, and from other sources, that some radio amateurs experience difficulty in the operation and construction of the continuous variable-induction type of receiver, which, is at present, so popular.

The troubles encountered can be divided into two main classes: Inability to tune to a sufficiently short wave length, and difficulty in controlling the regeneration effects, so essential in receivers of this type.

The first obstacle seems to be the main stumbling block. This is not the fault of the operator, but the fault of an improperly designed secondary circuit. The manufacturers, it appears, try to incorporate too large a wave length range in their receivers with the result that the instrument will not tune to amateur wave lengths. Most of the sets placed on the market today will just barely tune to 200 meters and only a few will tune to 150 meters. Thus it can be seen that in most cases waves below 200 meters can not be intercepted.

Fig. 1 Shows Front-Panel View of the Short Wave Regenerative Receiving Set Here Described in Detail. This Set Will be Found of Exceptional Value in All Amateur Receiving Work and it Is Very Simple to Build.

In the case of the second difficulty, where the plate circuit fails to regenerate properly, the trouble can generally be traced to improper connections or, perhaps to incorrect plate voltage. Trouble in this respect can be overcome by a little experimenting; for instance, by reversing the secondary connections or even the "B" battery connections. It may be, that the incorrect voltage is being applied to the plate. These obstructions can best be overcome by experimenting, because various tubes having different characteristics, require specific amounts of current for successful performance. The writer uses a Marconi detector tube and finds 40 volts on the "B" battery to be correct.

The following is a description of a receiver of the variometer type for amateur's waves, viz: Those between 150 and 375 meters. This set *works!*

I do not claim that other sets can not duplicate the performance of this instrument, but I do feel certain that any one constructing a set from this design will have a receiver of exceptional merit. This set is efficient for spark, continuous waves and radiophone reception. Using but one vacuum tube, stations 500 miles distant are copied nightly, and of course conditions being favorable this distance can be doubled or even trebled. The completed set appears in Fig. I.

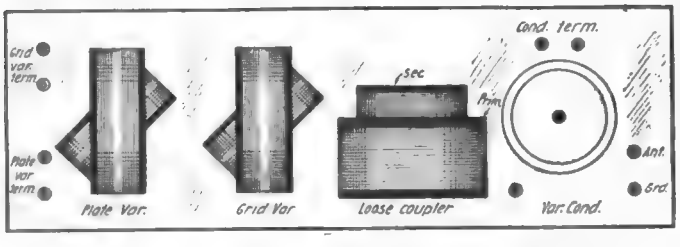

Fig. 4 Shows Rear View of Panel of Regenerative V. T. Receiving Set with Variometers, Loose Coupler and Variable Condenser in Place.

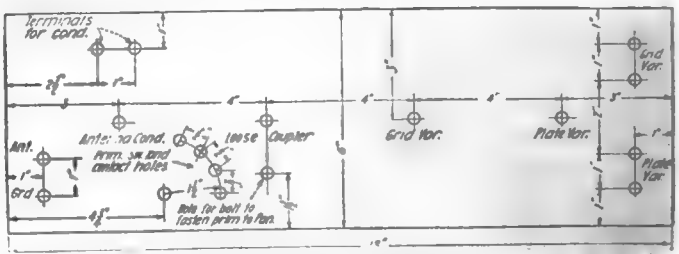

Fig. 2—Diagram Showing Dimensions for Laying Off Holes to be Drilled in Bakelite or Hard Rubber Panel, for the Short Wave Regenerative Receiving Set.

NECESSARY PARTS

Eight binding posts.
Four large knobs with dials.
Four No. 8-32 machine bolts 1½" long (brass).
One complete switch and four contacts.
About ½ lb. of number 26 S. C. C. wire.
Small bottle of yellow shellac and a quantity of No. 8-32 nuts. Some of these may be procured from old dry cells.

THE CABINET

The cabinet can be constructed from any suitable wood such as oak, chestnut or white wood. It measures completed 6"x6"x18". It should be constructed with screws but can be assembled with brads and glue.

THE PANEL

The panel can be made from any insulating compound such as hard rubber, bakelite or formica. Wood similar to the cabinet can be used, and in fact was employed in the tuner pictured. A 5/32 drill will suffice for all the holes in the panel. This makes a snug fit for the No. 8-32 machine screws. In this instance the panel was varnished and finished before the drilling was done.

THE COILS

In making this outfit two sizes of cardboard tubing must be procured. One piece 3" outside diameter and ⅛" thick, and the second piece 4" outside diameter by ⅛" thick. About six inches of each size tubing will be required. Three pieces of the 3" tubing must now be cut, each 1½" in length. Two sections of the 4" tubing the same length and a third section 2" in length. This should be given a coating of yellow shellac and put in a warmed oven to thoroly dry and shrink. Next two 3/16" holes should be drilled in each tube in the center and exactly opposite each other, except in the 4" coil 2" in length. This has a 3/16" hole drilled ½" from the bottom to provide for fastening the same to panel. Now we can begin the winding.

THE LOOSE COUPLER

The large 4" tube which is 2" long is used for the primary and one of the smaller 3" tubes is used for the secondary. Upon the primary tube wind 42 turns of wire, making taps at the 6th, 18th and 30th turns. Begin at the end opposite to which you have already drilled the 3/16" hole. When this is finished, wind the secondary coil upon the small 3" tube. The winding this time is in two sections of twenty turns each; leaving just enough space to clear the 3/16" holes in the center. This constitutes the coupler. All taps and leads should be only about ½ inch long, because green beaded flexible conductors are soldered to each. This insures tight connections.

GRID VARIOMETER

This variometer serves to tune the input (circuit) or secondary circuit. It consists of one of the small three inch tubes and one of the 4" tubes 1½" in length. The inner coil is wound in the same manner as the secondary coil, that is, in two sections, except that there are 25 turns to a section. The outer coil is wound in like manner with a similar amount of wire. This completes the grid variometer.

PLATE VARIOMETER

This variometer controls the amplification on regeneration by tuning the output on plate circuit to resonance with the input circuit, and thus causing it to oscillate, direct feed-back being avoided in this receiver. It is composed of the last 3" and 4" coils, each of course 1½" in length, wound with 36 turns of wire to a

(*Continued on page* 778)

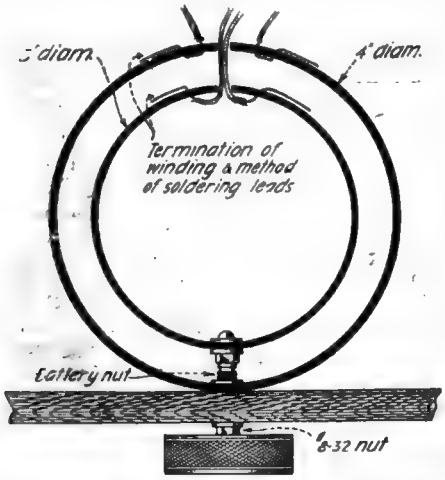

Fig. 3 Above, Shows How the Variometers and Loose Coupler are Assembled, the Moving Coil Being Mounted on a Single Shaft Formed of a No. 8-32 Machine Screw Secured on to the Knob at the Front of the Panel.

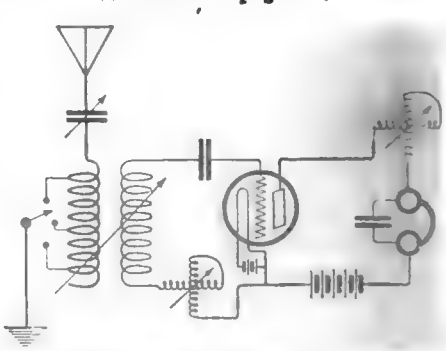

Fig. 5—Diagram Showing How Single Vacuum Tube Is Connected with the Two Variometers, Loose Coupler and the Usual Condensers and Batteries, for the Short Wave Regenerative Set, Described by Mr. Grace.

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What to Invent

By JAY G. HOBSON

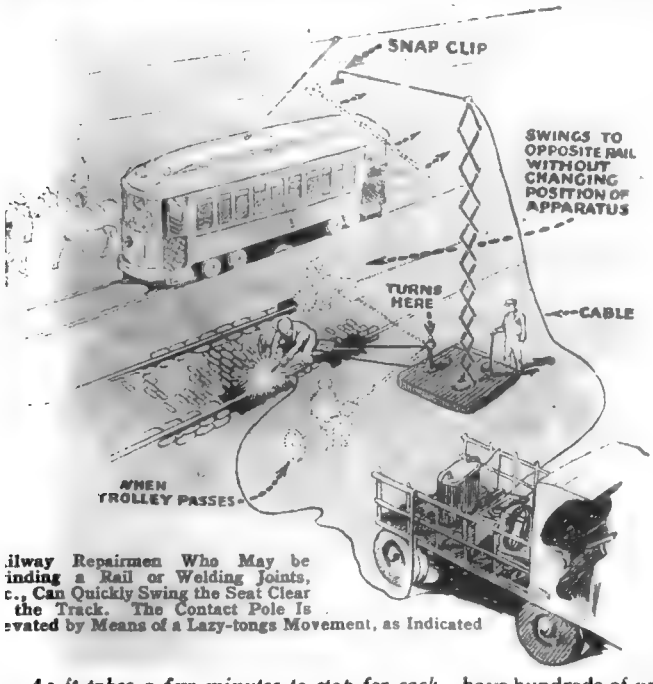
Improved Electric Welder

WHO said there was nothing new under the Sun? Now here comes our friend Makovich from the "Rubber City" with a brand new idea suggested for an improvement on electric welders and the like. Here's Makovich's suggestion:

"Dear Sir:

Did you ever stand on the sidewalk and watch a couple of men weld the car tracks, or the cable connections—taking the juice from the overhead trolley-wire? Every time a car comes along one man is needed to take off the "tapper" while the welder gets his seat (generally a wooden box) and his tools off the track to let the car pass, thus interrupting both the trolley service and the work.

Why not have a device like that shown in the illustration? It should be made so that it folds up in order to be kept in the auto truck with the rest of the outfit. When the operator sees a car coming, he simply has to turn out of the way a few feet, until the car passes and then turn back again to continue the job—with the smallest necessary interruption



ilway Repairmen Who May be inding a Rail or Welding Joints, c., Can Quickly Swing the Seat Clear the Track. The Contact Pole Is evated by Means of a Lazy-tongs Movement, as Indicated

As it takes a few minutes to stop for each car, using the present crude apparatus, the time that could be saved each day would probably amount to a few hours; especially so on city lines where a great many cars pass all day long. Without a doubt a device of this sort would be made cheap and sell easily to all traction companies. *John J. Makovich, Akron, Ohio."*

A Money Making Formula

There are hundreds of thousands of pianos in the homes of musical America, subject to rust and decay from dampness and other climatic conditions. Heretofore, no one has been successful in preventing the damage from rust. Recently, however, an excellent formula for a preparation for this purpose has come to my attention. It is of great benefit to musical instruments, and contains sufficient commercial merit to warrant recording it here.

This compound could be packed in three ounce bottles, neatly labeled and profitably sold thru agents and music stores at 25c to 50c per bottle. Every piano owner would buy this rust preventive after learning about it, and possibly would pay the agent additional money to apply it to the tuning pins and strings of their pianos. Here it is complete:

"A good coating for tuning pins and strings to prevent rust can be made by mixing one to two parts of Japan dryer to 10 parts of linseed oil. It prevents rust, does not peel off, and if applied sparingly, will dry quickly. It will not work into the wood. Piano strings break occasionally on account of rusted coils. This will prevent the coils from rusting and preserve the tonal qualities of the instrument."

An Emergency Umbrella

Many novel devices have been introduced, from time to time, in the form of folding umbrellas. A few have proven acceptable. But a real efficient umbrella for travelers has failed to put in its belated appearance. What is needed is a small, serviceable apparatus designed along the lines of a fan—to be compact when not in use, and easily adjustable in case of emergency.

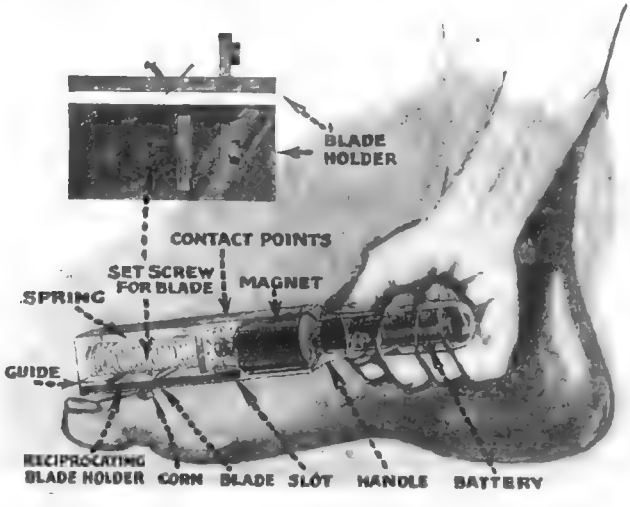
I believe one could be arranged in the manner illustrated: with ribs fastened to a center ring—and covered with waterproof material. A small, short handle could be secured to the underside of the center ring and the entire device carried inconspicuously. In case of a sudden downpour it could be opened quickly and held over the head instead of the unhandy newspaper often utilized for the purpose. Travelers, campers and tourists would buy this improvement on sight.

Yes, a Foldin Umbrella! How Many Times Have We Heard the Question Asked, Especially by the Women Folks, "Why Doesn't Someone Invent a Real Honest-to-Goodness Folding Umbrella, That I Can Put in My Traveling Bag?" Several Years Ago There Was a Folding Umbrella Shown in Some of the New York Shops, Which Was Made in France, if We Remember Correctly. Howsomever, the Problem Is Still Before Us of Providing a Good Collapsible Umbrella with Folding Ribs, Made in Some Such Manner as Here Illustrated, and Which Can be Placed in a Traveling Bag or Coat Pocket. Provided with a Suitable Waterproof Cover with Button Flap, This Device Should Find a Very Ready Sale in All Parts of the World. If There Is One Thing That the Average Man Hates to Carry, Not to Mention the Women, It Is an Umbrella, and the Author Has Left So Many of Them in Railroad and Street Cars, the Sun Having Come Out During the Journey, That He Has Lost All Track of Them, Simply Because They Have a Habit of Sliding Down Out of Sight Beside the Seat, and. . . Well, Here's Hoping That the Real Master Umbrella Genius Will Show Himself Shortly.

Safety Electric Corn Parer

Everybody has one or more corns on their feet that must be pared, husked or "Freezoned" as it were. True, we have hundreds of preparations that claim to eliminate, banish, exile and eradicate them while you sleep, but I stand as a living example and proof that so far the great American genius has failed to compound anything to beat cutting 'em down as required for comfort and peace of mind.

Now if this is true (and of course I can't be mistaken because of personal experience) why not invent a safety electric corn parer on the idea of the carpenter's planer? One constructed with a small blade to vibrate rapidly back and forth over the top of the pesky corn would shave it off a little at a time until the proper amount of toughened skin had been removed. A device made along this line should meet with instant approval from the corn-hating public, and chiropodists wishing to utilize the latest devices in their paring profession. Think it over, and if you have corns experiment on your own first, perfect your improvement, then let the world know about it thru advertising, and the public will scramble for the invention.



Speaking of "What to Invent," What Is the Matter with a Simple Electric Corn Parer? It Might Conceivably be Constructed so as to Utilize Old Safety Razor Blades and if Made Somewhat After the Fashion Here Illustrated, It Would Lend Itself Well to Operation on Batteries as Well as on the 110-Volt Lighting Circuit. The Electro-magnet in This Machine Acts to Vibrate the Blade Holder Back and Forth Over a Slot, as Becomes Evident Upon Inspection of the Drawing.

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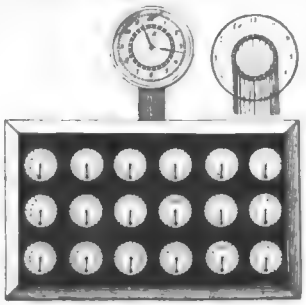
LATEST PATENTS

Hotel Room Calling System

(No. 1,384,182 Issued to Oreste Conti.)

Simple and ingenious is this idea of a room calling system for hotels. Never-



theless, the description will not be amiss here. The inventor replaces the gong of a master clock with a metallic brush and in addition, arranges the striking mechanism, so that the gong hammer will move five times for the hours and half hours. Each stroke will cause the hammer to hit the metallic brush closing the circuits to the various rooms. The master clock is arranged so that a brush constantly wipes metallic segments. Secondary clocks in series with these metallic segments are so arranged that when the master clock reads a certain hour, the circuit is completed thru those clocks which have been previously arranged to the same hour, and as the hammer strikes, the call bell in the corresponding room is sounded.

Ionization Current Regulator

(No. 1,388,527 Issued to Oscar H. Pieper and Alphonse F. Pieper.)

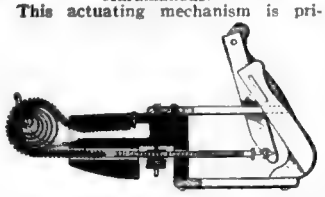
In the treatment of diseased teeth by means of electricity, a very weak bu

steady current is needed. In order to regulate this current more thoroly the cylindrical casing contains besides the necessary binding posts, a resistor, in which the insulating material is wound so as to appear curved in the form of a ring, its ends being separated slightly from each other. Comparatively high resistance is obtained by the use of very fine wire. A brush making contact with this resistor is connected into the circuit and is rotatably mounted, which rotation is regulated by means of two gears which mesh with each other. One of the gears is connected with a knob, the other upon which a scale is inscribed, is attached to the brush. A milliammeter is connected into the circuit.

Egg Beater Motion

(No. 1,384,135 Issued to Demetrios Karamanous.)

This actuating mechanism is pri-

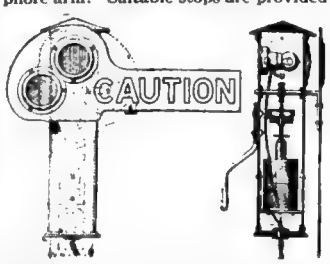


marily intended for egg beaters and the like. The beater is provided with a central shaft and is driven by a gear meshing with a rack. This specific application, however, deals more with the means for reciprocating the rack. As will be seen in the illustration, a coil spring is provided which is formed by a single piece of wire. This coil spring is arranged around a clockwork spring which has its inner end secured to a bar. The clockwork spring is free to expand or to contract. When the rack bar is moved toward the handle the long spiral coiled spring is drawn about the clockwork spring compressing it.

Automobile Caution Signal

(No. 1,391,120 Issued to Alfred James Jones.)

This device consists of a housing, which contains a lamp, a solenoid, and the other additional apparatus. A well balanced semaphore is connected to a shaft entering this housing. This shaft has attached to it a chain which partially surrounds it. The other end of the chain is attached to the core of the solenoid, which may be sufficiently weighted to assist in balancing the semaphore arm. Suitable stops are provided

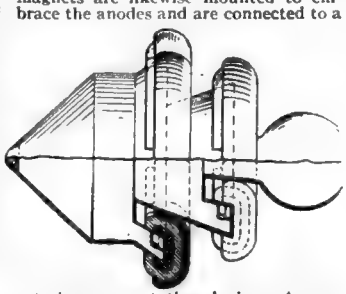


to limit the movement of the plunger of the solenoid. It will, therefore, be seen that a minimum current is required, and upon closing the proper circuit, the semaphore assumes either the danger position or is retracted behind the housing. At night a red or a green light shows, or is screened.

Inverted Rectifier

(No. 1,381,324 Issued to Friedrich W. Mayer.)

This contrivance consists of a hihgly exhausted receptacle composed of some non-magnetic metal or glass. A cathode of mercury is located in the lower portion of the container. Two upwardly extending flanges are formed in the wall of the container and so disposed that they are radial thruout their length with respect to the cathode. A plurality of anodes are mounted in these flanges so that there is a straight free arc path between each of them and the cathode. A plurality of electromagnets are likewise mounted to embrace the anodes and are connected to a

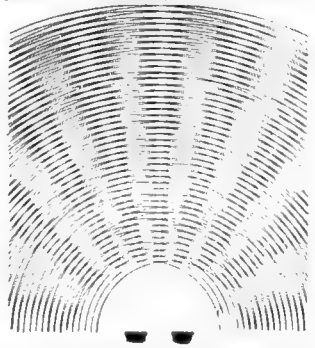


rotating commutating device. Assuming that an arc is to be started between one of the anodes and the cathode, the magnets are energized and said arc at once takes up a position between the pole-pieces of one of the magnets which is de-energized by a fiber disk mounted upon the commutating device. As each of the magnets is de-energized in rotation, the arc moves forward accordingly.

Sound Signaling

(No. 1,384,029 Issued to Reginald A. Fessenden.)

This invention aims to produce localized sound signals in the shape of interference fringes, that is, spaces where the sound is more concentrated than in other spaces. He arranges two oscillator

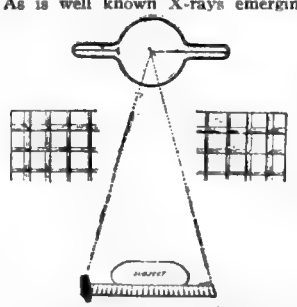


side by side which are so connected as to be in phase with each other. When this is the case, at all points along the line, at right angles to a line joining the centers of the diaframs of the two oscillators, the sound waves from each oscillator will arrive with the same phase. Consequently there will be received an intense sound proportional to the square of the number of oscillations along this direction, which in the arrangement shown pass down the center of the channel. Should there be any shifting either to the right or to the left of this line, the waves from the two oscillators will arrive in different phases and consequently the sound will be reduced.

Cell-Diafram for X-rays

(No. 1,381,521 Issued to S. Tousey.)

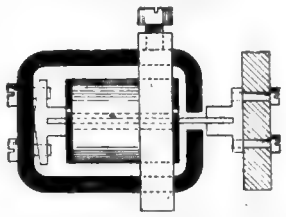
As is well known X-rays emerging



from a subject under examination, consist of those rays which have radiated from one or another part of the X-ray tube (those most desirable of course emanating from the focus point) and have past thru the subject in a straight line. The other form are those secondary rays arising in the substance of the subject which radiate in every direction, and other undesirable rays emanating from other parts of the tube. These have a very serious impairing affect upon an X-ray photograph. The inventor of this device, therefore, arranges a number of cells which are made of steel and which may take on the form preferred, that is square, round, or hexagonal, so that only the direct rays from the tube after penetrating the body will affect the photographic plate, while those secondary rays are absorbed.

Electric Reproducer for Phonographs

(No. 1,384,295 Issued to Henri Armagnat and Pierre Frely.)

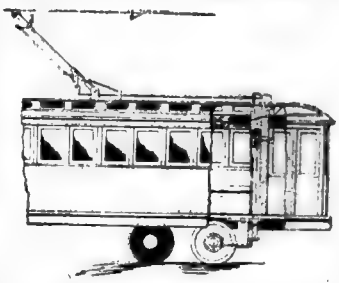


In this type of reproducer designed by these two Parisians, a vibrating blade is placed between the north and south poles of a magnet. This blade, due to its vibration, induces in the coil on either side a pulsating or alternating current. The entire apparatus is adapted to be placed upon the arm of a talking machine and the vibrations of the blade are due to the oscillation of this arm, under the influence of a needle or stylus which follows the groove already cut in the record. The pulsating or alternating current thus set up is employed to produce acoustic variations in telephone receivers or loud speaking devices.

Street Indicator for Railway Cars

(No. 1,382,845 Issued to De Ella B. Mayberry.)

Automatic signs for railway cars have been in vogue for quite a few years, and we wish they were more so. Briefly, the device consists of two roller signs which are actuated either manually or by gears, the sign itself being painted on a canvas or other strip, and

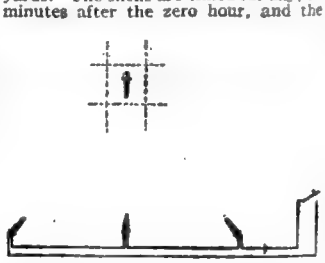


being revolved by means of a cam-shaped clutch, which permits one complete turn of the shaft to be made every time a trip alongside the trolley pole is released. This trip is so arranged that should the motorman of the car back away, the trip would not be broken. The tripping rack suspended from the trolley wire is easily applied by means of two small screws.

Method of Destroying Enemy Gun Positions

(No. 1,384,030 Issued to Reginald A. Fessenden.)

One of the most interesting inventions, which strange to say has not been suggested heretofore, is one for the destruction of enemy gun positions in the novel manner here outlined. Instead of using the older methods whereby guns were fired at random intervals at targets and therefore exploded at random intervals and in random localities, or instead of firing guns in volleys the inventor employs one, two, three, or more guns. These are so arranged as to cover, let us say, an area of 25 square yards. The shells are timed for say, 15 minutes after the zero hour, and the



guns will send their shells into the walls, embankments or grounds occupied by the enemy. A minute or so later, a second load of shells will penetrate enemy territory, etc. These shells would have been set so as to explode 14 minutes after the zero hour. When finally the enemy territory is fully loaded, firing ceases. Exactly 15 minutes after the zero hour the entire territory so mined by explosive shells, timed to explode at a certain moment, will be sent skyward.

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Scientific Humor

Ought To Be Lanced—She—"What's that bump on the front of the car?"

He—"Oh, the radiator just had a 'boil.'"—*George Reinhardt.*

The Secret of Success.—"Do you know," beamed the lecturer, to his class on chemistry, "as I came into the room this morning, I read a single word printed on the door; without which not one of you could dream of succeeding in the scientific world?"

"Pull," shouted the class in unison; and the instructor knew that he had taken his motto from the wrong side of the door. —*H. N. Alyea.*

And Repeat It Too.—RIGGS: "Why are women like telegraph wires?"

JIGGS: "Because they carry all the news."
—*George Stewart.*

A Long Rest.—Professor of Physics: "The pressure of bodies at rest is called force. Give an example, Harry."

Harry: "The police force."
—*Louise Probst.*

A Milk-shake-up.—"You are charged with selling adulterated milk," said the Judge.

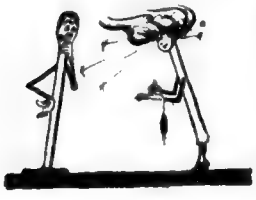
"Your honor, I plead not guilty."

"But the testimony shows that it is 25% water."

"Then it must be high grade milk," returned the plaintiff. "If your honor will look up the word 'milk' in the cyclopedia, you will find that it contains from 80% to 90% water. I should have sold it for cream."—*J. Oliver Hall.*

Gassed.—CHEMIST: "I should like very much to have an increase in my wages, sir. I was married yesterday."

BOSS: "I'm sorry, my good man, but we can't do it. The company does not assume any responsibility for accidents which happen to our employees outside the laboratory."—*D. C. Metzger.*



But Fire Consumes the Best Match.—"There's a perfect match."

"That couple there?"

"Yes; she's a spitfire, and he's a stick."
—*N. W. Phillips.*

Torpedoed.—Jiggs went into a restaurant and asked for an order of poached eggs on toast.

The waiter bellowed into the kitchen, "Two men on a raft."

Jiggs reminded the waiter he wanted the eggs well done and scrambled, whereupon the waiter again yelled back into the kitchen, "Shipwreck that order."—*P. Bell.*

A Rare Guess.—PROFESSOR TO STUDENT: "Mr. Blank, tell us something of the occurrence of calcium carbonate in nature."

STUDENT (unprepared): "Well, Sir, it-it is very rare—"

PROFESSOR: "Very good, sir, for a guess. But you failed to mention that the Appalachian mountains are composed quite largely of this rare substance."
—*George B. Hills.*

First Prize, $3.00

Correct at That.—Teacher in Physics: "A transparent object is one that you can look through. Now, name something that is transparent."

Billy Bright: "A doughnut."
L. Plebanek.

Telephones Not Rushin'.—"Why don't they have a good telephone system in Russia?"

"Because they are always having trouble with the Poles."—*Mason Crook.*

But the Battery is Juicier.—1ST ELECTRICIAN: "Why is a brick a better worker than a storage battery?"

2ND ELECTRICIAN: "That's easy, a brick is only fired once and a storage battery is discharged a great many times."
—*Stanley P. Andrews, Jr.*

It Might Flunk Too.—TEACHER IN PHYSICS: "Allen, explain fully how you would graduate a thermometer."

ALLEN: "Send it through High School!"
—*Elmar H. Smith.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Suppose He Had a Puncture?—Little Tommy was absorbed in a picture of Elijah going to heaven in his chariot. Pointing to the halo over his head, he exclaimed, "Look, Pop, he's carrying a spare tire."
—*James McMillan Joss.*

Better Than Perpetual Chatter.—"This living with a genius is a little trying," said the worried looking man.

"A genius! Didn't know that you had one in your family."

"Yes, my wife; she's discovered perpetual emotion."—*E. R. Carlstedt.*

Dry All Right.—Professor (in engineering class): "What is a dry-dock?"

Student in rear: "A physician who won't give out prescriptions."

—*Galvin Callinan*

Must Have Been a Bostonian.—An English teacher asked the class to write a sentence that meant the same thing as "A wink is as good as a nod to a blind horse." Some answers were good and some were bad, but she nearly fainted when she read this one:

"The closing of the right optic is as sufficient as a rapid inclination of the cranium to a sightless quadruped."
—*M. N. Brown.*

He Was En-lightened.—CUSTOMER "Say! do you remember the flashlight battery called 'Kwik Light' that I bought here the other day?"

DRUGGIST: "Yes, what of it?"

CUSTOMER: "Well, it should be called 'Quick Finish' because it has burnt out already."—*Philip Daher.*

Was It a Snap-Switch?—Dick: "Did you notice Rosy's hair at the dance last night?"

Bob: "Yes, her hair was light, and I always thought it was dark."

Dick: "Wonder what the reason could be?"

Bob: "Maybe she turned the switch on."
—*Solomon F.*

The Force of Habit.—"I would love, if I dared," said the enthralled young man to the fair ex-telephone operator, "to press some kisses upon those ruby lips."

"Yes?" she said abstractedly. "Number, please."—*S. McCrony.*

But Someone Will Be Electrocuted.—"That judge is a human dynamo. He electrified the courtroom during the trial."

"And what is he doing now?"

"Charging the jury."—*David Terrière.*

The Key to Happiness.—STREET FAKIR: "Gentlemen, my next article for sale is a magnetic key hole. When coming home late all you have to do is take the key out of your pocket on reaching the porch and it is attracted at once in the hole."

Later—Fifty men injured in the rush to get one.—*M. I. Stewart.*

With Chickens or Pockets?—Jim: "If you were attending a dance, and the hall was suddenly plunged into darkness, would you begin to 'light out?'"

Jam: "No, I would begin to make connections."—*H. C. Bearden.*

The Nasal Trombone.—PROFESSOR IN SCIENCE CLASS: "Who can tell me the scientific name of snoring?"

1ST STUDENT: "I don't know, Professor."

2ND STUDENT: "Sheet music."
—*William Dunphy, Jr.*

Ours Has Not a Fly Power.—Two little boys were talking about a small engine.

1st Little Boy: "I guess that engine is only one-horse power."

2nd Little Boy: "Naw, that's only a colt power."—*Winston Stonehouse.*

Up In the Air.—Capitalist: "If I lend you money on this dirigible plan of yours, what security can you give me?"

Aviator: "My priceless balloon itself."

Capitalist: "Excuse me, but I am not accepting any inflated securities."
F. Y. Heydon

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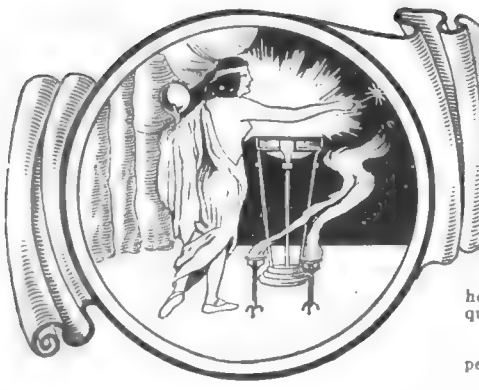


THE ORACLE

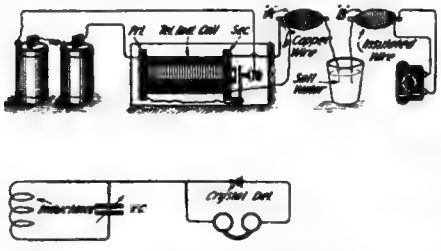
The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Unilateral Induction

(1165) Roy J. Martz, Miamisburg, Ohio, writes:

Q. 1. Referring to the diagram herewith, how is it that I could hear a sound in the telephone receiver?



The Experiment Shown in the Diagram Above With the Telephone Induction Coil, Batteries and Telephone Receiver, Resulted in a Sound Being Heard in the Telephone Receiver, and the Querist Was Puzzled as to Why This Should Occur, With but a Single Wire Connecting the Induction Coil and the Receiver. The Answer Is "Unilateral or One-wire Induction."

A. 1. Of course, you were able to hear induction from your coil in the telephone receiver for the very reason that you were getting a unilateral inductive effect along one wire, thus it is only necessary for you to place one lug of your telephone receiver against the contact screw of a buzzer, and you will also hear the sound.

We do not think that you will unearth anything remarkable by experimenting along this line, but it will never do you any harm. Loop aerials and concentrated aerials when used with audions, eliminate the large aerials.

In radio wave-meter circuits the detector and 'phones are frequently connected in a unilateral manner, as shown in the diagram, in order to check out the minimum and maximum sounds in the 'phones more easily and exactly, owing to less induction and the elimination of shunt circuits across the tuned wave-meter inductance and condenser.

Double Airplane Propellers

(1166) F. V. M., Detroit, Michigan, writes this department:

Q. 1. I have a plan for a double propeller on an airplane. The idea looks practical, but before going ahead and making up a working model or having it patented, I would like to know if, from your experience, a double propeller with the blades rotating in opposite directions from one crank shaft, is practical or advantageous in any degree for present day airplanes.

A. 1. Regarding a proposed double propeller for airplanes, we have consulted an aeronautical authority in the matter, and he gives the following data on this idea.

This idea is not so new in some of its aspects, as it has been developed and applied successfully on the modern automobile torpedo, in order to cause the torpedo to follow a given course more exactly and to minimize any turning efforts of the torpedo in the water. About the only thing that would be gained by utilizing two propellers mounted on the same shaft axis, the blades of the two propellers being of opposite pitch and driven in opposite directions, would be to minimize the natural gyroscopic or turning effort of the average airplane, caused by the rotation of the one propeller in a single direction.

The idea of using this principle of two concentric propellers on an airplane in the manner you describe, would not result in any increase in speed or in any other decided improvement, but it might when thoroly developed and tried out, prove very advantageous by minimizing the gyroscopic or turning effect of the single propeller.

He also stated that in any event, the mechanical problems encountered in applying this type of drive, could undoubtedly be overcome so as to render the operation of the double propeller smooth and reliable. The propellers would have to be built very accurate and well balanced, and also precautions would have to be taken to insure that the speed of both propellers would be exactly equal.

In closing we might suggest that the same effect has been obtained on large airplanes and also a number of vessels, where two or more propellers are used, by spacing these a fairly good distance apart, say 10 feet to 15 feet or more, and having each of say two propellers operated in opposite directions. This nullifies the turning effect on the airplane, caused by one engine and propeller, and in the case of a ship cutting thru the water, a more even drive and easier steering results.

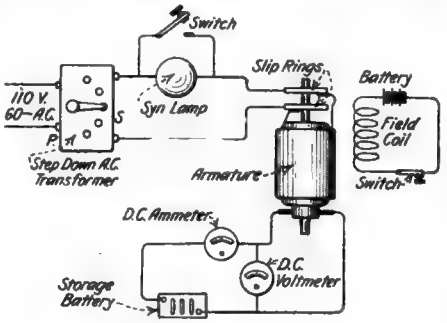
Rotary Converter

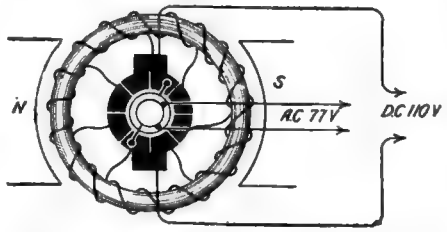
(1167) Don Lownsdale, Philadelphia, Pa., wants to know:

Q. 1. How to procure direct current from alternating current circuits, using a rotary converter.

A. 1. Herewith is a diagram showing how to convert a motor into a rotary converter so that it will give direct current for charging storage batteries.

The armature of an ordinary motor is generally made up of sections, if it is the ordinary D. C. type. The armature is tapt and furnished with both commutator and collecting rings. The slip ring A. C. leads are taken off from diametrically opposite commutator segments. The motor is accelerated to synchronous speed by another motor or by operating it on direct current thru the commutator. When the synchronizing lamp is dark for an instant close the lamp cut-out switch, and the motor will operate as a synchronous machine at constant speed. The auxiliary starting motor or the D. C. supply to the commutator must be cut off at the same time, or the machine will get out of step and come to a stop. The machine will supply both D. C. and A. C. if driven by another motor. The A. C. voltage rating of the machine is .7 of the D. C. voltage rating, i. e., 70 volts A. C. for a 100 volt D. C. machine, etc. It can thus be made to deliver direct current while running as an alternating current synchronous motor. At the same time the field coils will have to be excited by a storage battery or other source of direct current, in order to keep them magnetized.





This Diagram Shows How a Small Rotary Converter May be Operated from a Step-down A. C. Transformer. The Two A. C. Slip Rings are Connected to Diametrically Opposite Commutator Segments, as Shown in the Lower Diagram. The Field Winding of the Machine Is Excited from a Battery or a 110-Volt D. C. Circuit.

Manufacture of Oxygen

(1168) H. C. Hess, Oneida, N. Y., asks about the manufacture of oxygen on a small scale for commercial purposes.

A. It will probably prove quite impossible for you to manufacture oxygen on a small scale for regular traffic and sale so as to show a profit.

Some concerns are making oxygen by the liquefying air process and separating the nitrogen. The nitrogen, of course, evaporates faster than the oxygen, and oxygen is left. It is comprest in cylinders for sale.

For small quantities, oxygen may be made by heating a mixture of potassium chlorate and manganese binoxide.

Other manufacturers are making oxygen by electrolytically decomposing water. The liquefaction of air method is fully described in Dr. T. O'Conor Sloane's book on "Liquid Air." The expense of installing and operating a plant would be so great that you could not possibly make a profit on the proposition.

Welding Transformer

(1169) Wm. B. Hosking, Great Falls, Mont., asks:

Q. 1. For description of a transformer to be used with the electric welding apparatus described in one of our recent issues.

A. We give herewith data for a ½ K. W. step-down transformer. The length of the iron core is 15 inches; width, 8 inches; and thickness, 2 inches, wound with a primary of No. 10 B & S gage, double cotton covered magnet wire, 344 turns being required.

The secondary leg is wound with No. 4 D. C. C. magnet wire, 139 turns being necessary. Two No. 7 wires could be used in the latter case.

Tesla Gasoline Turbine

(1170) Mr. H. L. Herbert, Phila., Pa., asks for the leading features of the Tesla gasoline turbine.

A. In reference to the Tesla gasoline turbine we would say that the steel discs in this turbine are perfectly flat on both sides, the expansion of the gases causes friction against these steel discs. One little flat steel disc having a diameter of no more than 12 inches is said to be as efficient as a whole bucket wheel in the ordinary turbine. The explosions can be speeded up to such an extent that a high musical sound is the result, altho they may occur much slower. The slot in the nozzle thru which the gases pass is continuous along the entire length of the discs. See the July, 1920, issue of this journal for detail drawing.

The principle of operation of the Valvular Conduit is very simple. The gasoline is under pressure and passes in almost a straight line into the engine. When there is an explosion the force divides the gases so that one stream travels straight ahead, and another stream goes into one of the side pockets. In this way one gas stream bumps into the other stream of gas reducing its force considerably, and this takes place along almost the entire length of the conduit. The exhaust gases pass to the center of the turbine where, due to a powerful blower action which occurs there, the gases are expelled.

In starting the motor some form of exhaust is employed which creates a suction. The consumption of gasoline is low, the percentage of efficiency being 84 or even higher.

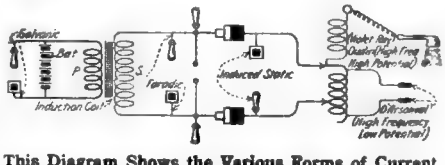
High Frequency Currents

(1171) Harvey B. Paul, Port Carbon, Pa., asks:

Q. 1. What is the difference between Faradic, Oudin, and D'Arsonval currents?

A. 1. We enclose herewith a diagram of the connections for the various kinds of current used in electro-therapeutics. You are at present using the secondary of an Oudin high frequency high potential transformer of which one wire is connected to your violet ray tube. This is not a genuine generator of ultra-violet rays, but just plain violet rays, so called because of their color.

You can build apparatus to obtain any or a combination of all of these currents, and in doing so you will have the only positive method of knowing just exactly what current you are using, unless of course you intend to buy a very expensive and elaborate outfit.



This Diagram Shows the Various Forms of Current Which May be Taken from a High Frequency Outfit.

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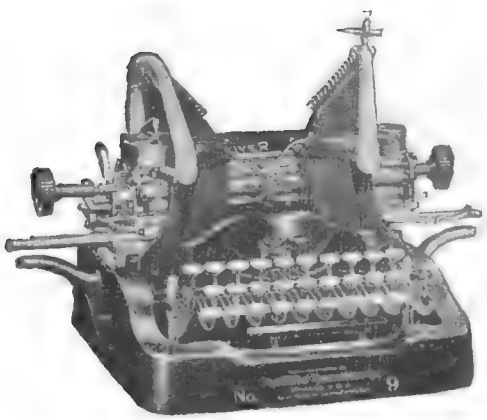
Standard Model **The Oliver Typewriter** *Latest and Best Oliver*

Monthly Installment Price, $55

Cash Price NOW $49.50 Brand New

FREE TRIAL



EASY TERMS

The Oliver Typewriter Company announces a further reduction in price of the latest and improved Oliver No. 9—formerly $100—lately $64. The price alone is changed—not the standard model that has won such fame. Over 900,000 have been sold.

This offer is based on the fact that the Oliver has proven that it sells itself. We ship it direct from the factory to you, saving you the cost of selling.

If any typewriter is worth $100, it is this sturdy, proven Oliver, the finest, the costliest Oliver ever built.

A sensational offer

The new reduction is due solely to our simplified method of selling. It created a sensation in 1917. To abandon the standard price of $100 won the approval of the public. We now make a further reduction, anticipating lowered costs of production.

We now reduce the price to $49.50 for cash or $55 on installments, with over a year to pay.

The coupon brings the Oliver to you for five days' free trial. Be your own salesman. If you agree that it is the finest typewriter that any price can buy, you can save yourself half the usual price.

When it arrives, put it through every test and comparison with other $100 standard typewriters. Then if you want to buy it, send $49.50 in cash. Or if you wish to take advantage of the installment plan, send us $3, then $4 per month until the $55 is paid.

If you decide against it, ship it back at our expense. You do not risk a penny.

Remember, this is a brand new Oliver, fresh from the factory—not second-hand, not rebuilt. Do not let the remarkably low price confuse you.

Finest Oliver ever built

This is the standard $100 typewriter, but it is sold direct from the factory to the user. You do not have to pay for an enormous army of salesmen nor for a costly chain of branch houses in 50 cities.

You get exactly what $100 or more brings the usual way. And you keep what otherwise would be spent in selling you a typewriter.

Merely mail the coupon below for a Free Trial Oliver or for further information. Check which.

This method has been in use for 4 years. Thousands have taken advantage of it. Why should *you* pay double—when double cannot bring more? This announcement is bound to bring a flood of orders. Mail the coupon NOW, so your order can be filled promptly.

Canadian Price, $79

The OLIVER Typewriter Company
679 Oliver Typewriter Bldg., Chicago, Ill.

You can save $45 on our time payment plan. It costs us $5.50 to carry your account for 14 months. If you pay cash you

SAVE $50.50

THE OLIVER TYPEWRITER COMPANY,
679 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit you $49.50.
If I decide not to keep it, I will ship it back at your expense at the end of five days.
My shipping point is.....

☐ Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

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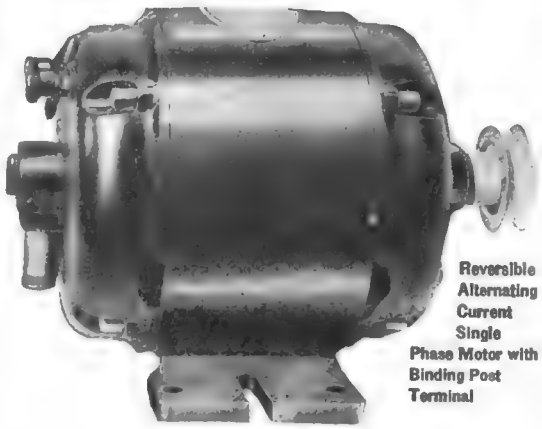
Xmas Bargain $11.75

¼ H-P. Electric Motor Fully Guaranteed, As Low as

AS we have only about 1,300 motors left, the following prices can be quoted only while this stock lasts:

100 lots, each.	$11.75
25 lots, each.	12.00
12 lots, each.	12.25
6 lots, each.	12.50
3 lots, each.	13.00
Single motors..	13.50

F. O. B. CHICAGO



Reversible Alternating Current Single Phase Motor with Binding Post Terminal

This is a motor that is giving splendid satisfaction to the owners of hundreds of thousands of electric household washing machines, churns, cream separators, ventilating fans, lathes, drills, grinders and similar devices. It is remarkably sturdy in construction, simple in design and efficient in operation.

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Science on the Stage

By ERIC A. DIME

(*Continued from page 706*)

twinkling of an eye and then made to reappear before the gaze of the startled spectators. The photos of this production here reproduced were taken by Roy J. Pomeroy, thru special color filters.

RADIUM PEARL SCENE FROM "MUSIC BOX REVIEW"

ONE of the most remarkable of the recent productions now playing in New York City is to be seen at the Music Box Theatre. We refer to the famous Pearl Scene, which has created no end of comment both from an artistic, and from a scientific, point of view. To give the reader a slight inkling of what it is all about, he should understand that the cost of this scene alone—and it lasts less than five minutes—is over $25,000.00.

We first see a dozen young ladies coming on the stage wonderously bedecked with strings of pearls, pearl necklaces, pearl bracelets, pearl hats, even pearls on their shoes. Naturally there are a series of "ohs!" and "ahs!" mainly from the female spectators in the audience. Our top photograph gives an idea of the pearl display.

The pearls alone would be wonderful enough for any production, but now comes science and takes its turn. Without warning every light in the entire house is turned off suddenly, and we now see on the stage nothing but the pearls, shining in a weird light. The effect is indescribable when first viewed, as nothing but the figures of the girls, outlined in softly luminous pearls, can be seen. There is a gasp of delight and amazement from the audience, and then the excited buzz, "How is it done?" The glow of the pearls is exactly the sort of light you are accustomed to see on a radium watch dial. It is a green, soft, luminous radiation. The secret lies in the phosphorescence of certain chemicals of which there are a number, as for instance, calcium sulphide, calcium fluoride, barium sulphide and many others.

The pearls themselves are filled with some of these substances, and for ten minutes prior to the appearance on the stage, the girls have stood bathed in the glow of powerful arc lights. The pearls, filled with the phosphorescent material, respond to the light in such a way, as to make it possible for them to give, when all other light is taken away, a temporary luminosity, soft and yet strong enough to be seen very clearly. The effect against the intense blackness, is striking beyond words. It is a simple application of science, to the needs of the stage, and we hope our scientists will occupy themselves with other similar achievements, which will give them a rich reward.

CHEAP HYDROGEN FOUND

The Paris *"Matin"* points out the importance of a discovery that has just been perfected by a French scientist, Prof. Georges Claude. It is some years since M. Claude first succeeded in achieving the synthesis of ammonia by subjecting nitrogen and hydrogen to very high pressure.

The process has now entered upon the practical stage, thanks to a new discovery by the same scientist, whereby hydrogen may be obtained cheaply from steam treated with red-hot coal.

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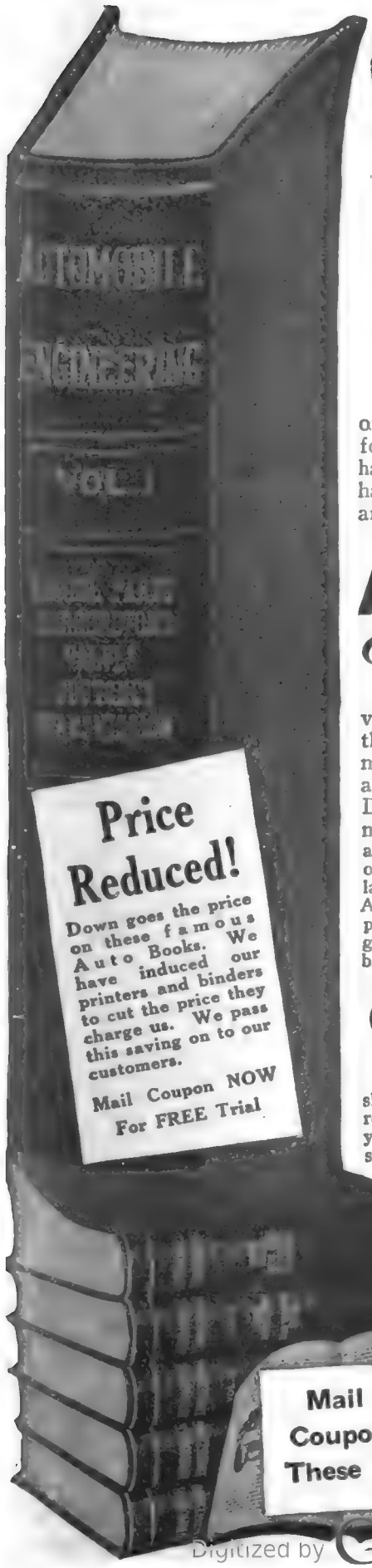
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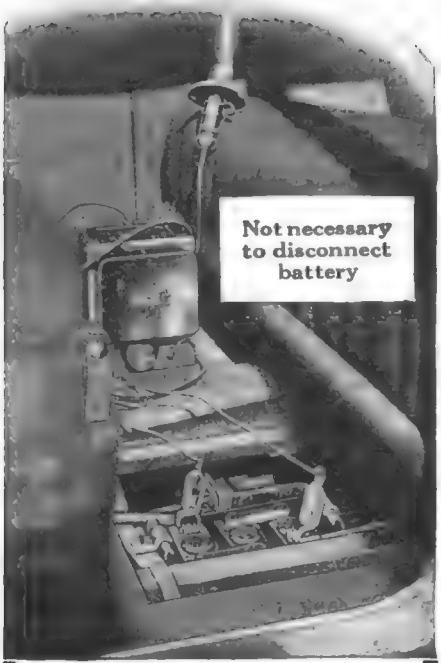

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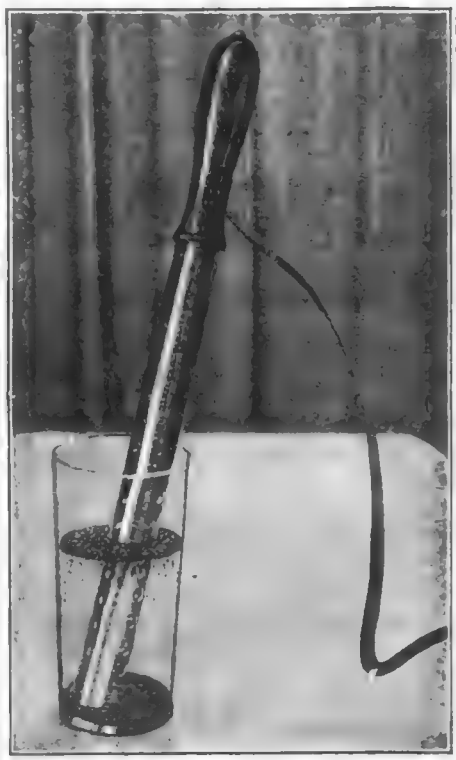
An Electric Liquid Purifier

Many novel experiments are the outcome of a new tubular arrangement shown in the illustration herewith. Fundamentally, the device consists of a handle into the end of which are inserted two metallic rods of an alloy called condite. This alloy contains a considerable amount of aluminum. These strips are connected directly to two leads and are inserted into a socket of the house-lighting system thru the agency of the regulation plug attachment. One of the most spectacular experiments, but very easily tried, is the placing of a few drops of ink in a glass of water. Insert the electric condite converter and a few moments later the ink solution is completely clarified and the ink may be seen to break up into lumps floating to the top or falling to the bottom of the



New Electric Purifier for Liquids, Which Acts on the Electrolytic Principle.

liquid. This ink defies any attempt at again mixing it with the water, and if allowed to stand for a few moments, more ink will separate from the water without additional treatment. Such is the case if brown sugar is substituted in place of the ink, a white liquid remains while the brown solid separates. If wood alcohol and water are mixed, it is well-known that a white, milky effect is produced. If treated with this device the mixture becomes perfectly transparent, while the milky substance separates. Grain alcohol, which contains paraffin, could not be filtered clear, but if treated with this device the paraffin separated and settled to the bottom. Hard water is softened by this means and rusty iron water, the color of a red brick, is cleared in two minutes. Nevertheless the operation of the condite converter does not cease there, in that wines and beverages may be aged very rapidly with its use and it is claimed that their taste is improved greatly.

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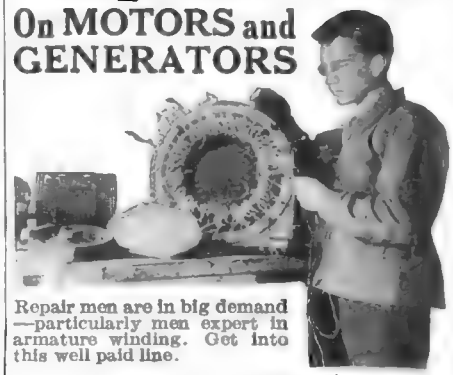

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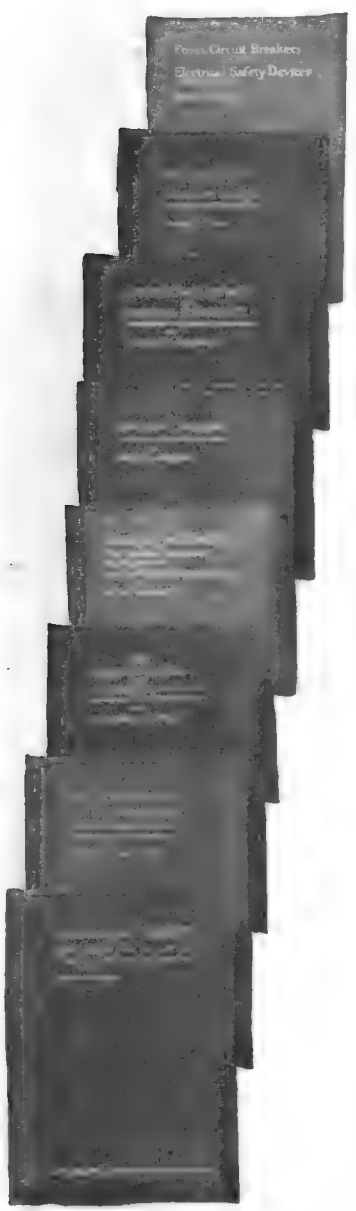

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Undulatory Energy of Ether Waves

By FRED R. HIGBY

Below is a table of the various forms of energy with their wave lengths and rates of vibration, as recognized and studied by modern science. The values given are the latest and most reliable to be found. The frequencies were obtained by dividing the wave lengths into the velocity of transmission through space. It should be remembered that all these forms of energy excepting sound are alike in their natures; they are but different rates of vibration in the luminiferous ether of space with a uniform velocity of transmission, *i. e.,* 299,860,000 meters per second. Although they seem to our senses to be very unalike, that is because their waves affect our senses differently. These forms of energy are really different aspects of a single one which is known as radiant energy. There is one more kind of radiation which belongs above X-rays and that is the Gamma rays which are emitted by radioactive substances, but since its wave length is as yet unknown it is not placed in the table. Another kind known as N-rays is suspected by some scientists, but its existence has not been proven.

Sound waves are included in the above table for convenience in reference, but they are not properly to be clast with the rest for the following reason: Sound waves are not carried by the ether at all, but they are transmitted by solids, liquids and gases. The velocity of sound waves is not the same in each of these substances, but it varies according to the material, temperature and other conditions. In dry air and at 32 degrees Fahrenheit the velocity of sound is 33.3 meters per second.

TABLE OF VIBRATIONS

Name	*Wave Length*	*Frequency*
X-rays	.00000001 to .000000055 cm.	545,200,000,000,000,000 to 2,998,600,000,000,000,000 per second.
Actinic rays	.0000084 to .0001 cm.	299,860,000,000,000 to 3,569,761,904,761,904 per second.
Light rays	.0000396 to .000076 cm.	394,552,631,578,947 to 757,222,222,222,222 per second.
Heat rays	.00004 to .00845 cm.	3,548,639,053,254 to 749,650,000,000,000 per second.
Electrical waves	.381 cm. to 25,000 m.	11,994.4 to 78,703,412,073 per second.
Sound waves	.80809 cm. to 20.7073 m.	16 to 41,000 per second.

NEW ELECTRO-PLATING PROCESS

The discovery of a new process in electroplating, which experts in the industry claim will increase output by 100 per cent as well as save thousands of dollars on plant and equipment, has been announced by Mr. Frank Mason, lecturer in electroplating and electro-chemistry at Sheffield University (England). The process has been successfully applied on a limited scale in workshop practice, and has given an increase of 100 per cent in productivity from the plating baths. There is evidence that further development will give much more startling results.

The discovery is based on the fact that rapidity of deposition of metal on any article that is being electro-plated depends on the strength of the electric current. In present practise, if the electric current is increased beyond a given standard the "plate" is spoilt ("burnt"), altho the plating is more rapid. But Prof. Mason has discovered that by varying the chemical composition of the plating bath (the electrolyte), it is possible not only to more than double the current of electricity put into the bath, and thereby make it do the work twice as quickly as in the present practise of the trade, but a "plate" of the finest and best results. He has discovered how quick plating can be done.

SCIENTIST STUDIES EFFECTS OF GALES ON HUMAN RACE

Dr. Stephen S. Visher, who has received the Bishop Museum fellowship from Yale University, is in Honolulu, T. H., to make a study of the influence of climate upon the people of the Pacific, with special emphasis upon the cyclonic storms of which kona winds are the manifestation in Hawaii.

"The effect of storms upon ships at sea has been extensively studied," said Dr. Visher, "but little thought has been given to their influence upon the health, minds and activities of the people and upon agriculture and industry.

"The kona is a mild form of hurricane which results from a difference in intensity in low air pressure areas.

"The effect of these winds upon the people is very depressing temporarily, but it is my belief that the reaction after the resumption of the trade winds is so beneficial as to more than overcome the temporary depression."

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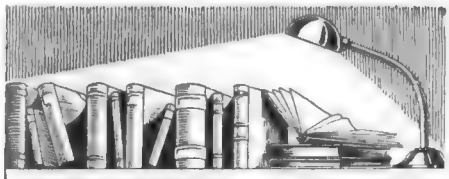

BOOK REVIEW

CREATIVE CHEMISTRY. Descriptive of Recent Achievements in the Chemical Industries. By Edwin E. Slosson, M.S., Ph.D. Profusely illustrated. Cloth covers, size 5¼" by 8¼", 311 pages. Publisht by the Century Co., New York.

Dr. Slosson, literary editor of "The Independent" and an associate in the Columbia School of Journalism, has written a marvelously interesting book. He has the quality of making his subject thoroly readable and thru elaborate illustrations, picturesque description, and even what we may term "topical" allusions, makes it popularly interesting.

Not for one moment must the reader consider, however, that his picturesqueness interferes with the value of the book. Few professional men could read it without great interest and benefit. The short appendix and reading reference is of high value, and the charm of the book is in great measure due to its literary quality, which makes it in the good sense better reading than the typical novel of the day. Dr. Slosson has covered very wide ground and a quantity of subjects, and the least that can be said is that he shows full understanding of the many topics.

We strongly recommend this book to our readers.

20TH CENTURY GUIDE FOR MARINE ENGINEERS. Questions and Answers. By J. A. Ramsey and J. Rosbloom, C.M.M. Numerous illustrations. Cloth covers, size 5" by 7", 537 pages. Publisht by the David McKay Co., Philadelphia, Pa.

The only criticism of this book is a minor one, but had it not been incurred, the book would be considerably better. We refer to the headings of the pages,—it is a great pity that the name of the book is run as a heading on both the odd and even numbered pages.

Numerous illustrations, intelligent paragraphing with captions and with questions and answers on the different topics make the book a thoroly practical one for study. It covers both steam and internal combustion engines, turbines, dense air ice machines and the many topics which have to be studied by the marine engineer, and with which he has to be thoroly familiar.

WIRELESS TRANSMISSION OF PHOTOGRAPHS. By Marcus J. Martin. Second Edition, Revised and Enlarged, 1919. Clearly illustrated. Cloth covers, size 5½" by 8½", 143 pages. Publisht by the Wireless Press Ltd., London, England.

When one realizes how new a thing wireless telegraphy is, it seems very impressive to have an entire book with illustrations and full detail of processes devoted to the transmission of pictures by wireless.

It is not easy to review this book as it naturally goes into detail, and has numerous illustrations required for the elucidation of the text. The thoroness with which the subject is treated may be judged by the fact that there are 77 illustrations in the text. Selenium receives considerable attention, an entire appendix being devoted thereto.

There are appendices touching on photography and lenses, and an excellent index is given.

RADIO TELEPHONY. By Alfred N. Goldsmith, Ph.D. Fully illustrated. Cloth covers, size 6" by 9¼", 247 pages. Publisht by the Wireless Press Ltd., London, England.

A book devoted to the wireless transmission of the voice seems very properly to follow in review the last book treated of.

For many generations, man was content to communicate his voice by wireless methods, until the achievement of the early electric voice transmission by wire was hailed as one of the world's greatest inventions. Now curiously enough, the wire is again being discarded and the days of wireless transmission of voice are returning, but this time by the utilization of the ether, as far as we know, and certainly not by air waves.

The book is very complete. There are 226 illustrations and an absolutely thoro index.

LIGHTING THE HOME. By M. Luckiesch. Cleverly Illustrated. Cloth covers, size 5" by 7½", 289 pages. Publisht by the Century Co., New York.

This book comes from one of the Research Laboratories of the General Electric Company.

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WIRELESS TELEGRAPHY AND TELEPHONY. By L. B. Turner. Cloth covers, 5¼" x 8¼", 207 pages. Illustrated. Publisht by MacMillan & Co., New York.

This is a carefully thought out, mathematical treatise on the subject of radio work, with very numerous illustrations, which we believe will be welcomed by the advanced students of wireless. The rapid development of the science and the changes it seems to be subjected to every day, make it hard to keep up with. But the writing of such books as this is certainly a very fine piece of work and cannot be too greatly appreciated by the real student of the science.

COCOA AND CHOCOLATE. By A. W. Knapp. Cloth covers, 5¾" x 8½", 210 pages. Well illustrated. Publisht by Chaplan & Hall, London, England.

This book gives a very full account of the production of cocoa, its cultivation, harvesting and preparation for consumption. It has numerous illustrations, many of them giving scenes from foreign countries and in the factories nearer home, which make the book quite attractive, as it is opened. We note in the introduction that the author speaks of it being the food of the gods, theobroma, attributing this name to Linnaus. It is supposed that he must have been inordinately fond of it. He also brings out the confusion due to similarity of names between the cocoanut and cacao bean. It is evident that the author is thoroly charged with the subject, and he certainly has succeeded in presenting it in the most attractive form to the public. It is profusely illustrated, has a bibliography going back to the year 1600, and is indexed satisfactorily.

PRINCIPLES OF RADIO COMMUNICATION. By J. H. Morecroft. Cloth covers, 6" x 9", with numerous diagrams and illustrations. 945 pages. Publisht by John Wiley & Sons, New York.

We have to make the same excuse in our review of this book as we have for the review of other books that it is so exhaustive and covers the ground in such detail that it does not lend itself to a review within the limits of our space. Looking it over, it seems as if nothing essential can have been omitted from it. Its pages, upwards of 900 in number, with numerous illustrations and diagrams, would seem to cover the whole subject. We do not know while formulae are used, that there are not enough of them to frighten off the reader; for it is well known that mathematical expressions do have a frightening effect on many.

THERMODYNAMICS AND CHEMISTRY. By F. H. MacDougall. Cloth covers, 5½" x 9", 396 pages. Publisht by Wiley & Sons, New York.

Modern chemistry is getting to be a very abstruse science. The author's preface starts in by reference to Willard Gibbs and Max Planck. He says that the writings of Gibbs will always be the admiration (and sometimes the despair) of the student of thermodynamics. When we turn over the pages of this book, with its differential and logarithmic formulae, it looks as if it might also bring the weakling student into a despairing state of mind. Yet when an author so thoroly understands his subject, we believe that the student should be willing to attack it without undue feelings of apprehension, and the spirit expressed in the preface is certainly one of encouragement.

AIRPLANE PERFORMANCE CALCULATIONS. By Harris Booth. Cloth covers, 5½" x 8¼", 222 pages. Publisht by Dutton & Co., New York.

In this book we have at last all the details of airplane construction treated mathematically, with liberal use of the calculus, so that it seems as if the science is being put upon an exact basis. It does impress one, however, that one thing should be remembered, which is, that the airplane is still in the realm of development, and that the present aspect of the subject, so exhaustively and mathematically treated in this book, may indeed change in the near future. But it is a great relief to see the subject brought outside of the rule of thumb.

CAM DESIGN AND MANUFACTURE. By F. B. Jacobs. Cloth covers, size 6" x 9", 121 pages. Publisht by D. Van Nostrand Co., New York.

Today the design of a cam means a great deal, the action of so many machines depends upon its contour. An immense amount of thought and experimenting has been devoted even to the cams operating the valves of the internal combustion engine, and that is only one among many other machines where cam action is all important.

The extensive and extending introduction of automatic machinery makes the subjects of cams a very live one. The book is liberally illustrated and well indexed and we are glad to recommend it to our readers.

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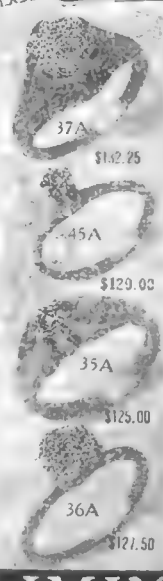

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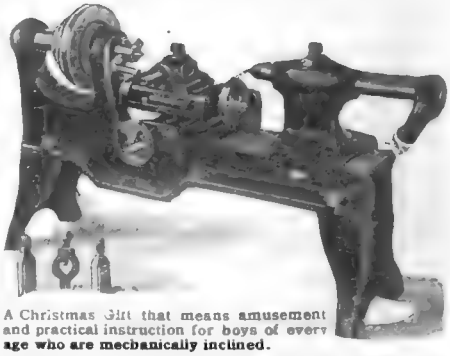

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ELEMENTARY MACHINE SHOP PRACTISE. By James A. Pratt. Cloth covers, size 5½" x 8", 320 pages, thoroly illustrated. Publisht by D. Van Nostrand Co., New York.

This work, in considerable detail, with numerous illustrations, a glossary, table and bibliography, is addrest to the young man who is studying to be a mechanical engineer. It seems to be very carefully thought out and very excellently arranged. The illustrations are clear and thruout one feels that the author is addressing distinctively the learner. The idea of the glossary is to supplement the text, so that what is not given in the text in virtual definition will be found in the glossary in clear explanation.

LABORATORY GLASS BLOWING. By Bernard D. Bolas. Cloth covers, size 5" x 7¾", 106 pages, illustrated. Publisht by E. P. Dutton & Co., New York.

The experience of the writer is that laboratory glass blowing is generally pretty poor work, the reason for which is that proper instruction is lacking. This little book in its 106 pages with numerous illustrations, really undertakes to teach the student the details of the work, and it is principally in ignorance of the method that the defects of the beginner in glass blowing originate and due to much ignorance that they persist. We certainly welcome the book. Its numerous illustrations are one of its best features.

CHEMICAL WARFARE. Amos A. Fries and Clarence J. West. Cloth covers, size 6" x 8", 445 pages, illustrated. Publisht by McGraw-Hill Book Co., New York.

This is an exceedingly interesting book in its text, and the interest is greater because it is so fully illustrated. It is written by one who knows his chemistry and certainly leaves nothing untold relating to the subject. Not only are the various gases described, but gas masks, absorbents, and all the palliatives are given. It is so well done with its numerous illustrations that it is really a study in chemistry to go thru it.

Chemical warfare seems barbarous, but until people stop fighting, war in its most abhorrent shapes has to be contemplated and provided for. We are very glad to recommend the book to our readers. It makes excellent reading outside of and in addition to its technical value.

THE MODERN ELECTRO-PLATER. By Kenneth M. Coggeshall. Cloth covers, 4¾" x 7¾", 276 pages illustrated. Publisht by N. W. Henley Publishing Co., New York.

The N. W. Henley Publishing Co. has done good work for many years in the production of useful and attractive technical books. A great deal of interest is now felt in electro-plating, and it is a branch of technology constantly developing and changing. A book like the one before us, bringing the subject well up to date in all its particulars, from the handling of acids in carboys down to the details of the actual plating operations, is certainly to be welcomed, and its numerous illustrations add greatly to its value. We gladly commend it.

PLANT PHYSIOLOGY. By Daniel T. MacDougal. Cloth covers, size 6" x 8½", 366 pages, illustrated. Publisht by Longmans, Green & Co., New York.

All we can say of this book is that it is so extended, adequate, and goes into such detail that it does not lend itself to review within the limits of our space. It is very fully illustrated, has very full references to books and authority, and in a word, we cannot say too much in its favor. A fine-type index of over ten pages also operates to incline the reviewer to a favorable state of mind.

STUDIES IN ELECTRO-PHYSIOLOGY. By Arthur E. Baines. Cloth covers, size 5¾" x 8½", 291 pages, illustrated. Publisht by E. P. Dutton & Co., New York.

A good deal is now appearing in the scientific journals on the effect of electrical excitation or of electric currents on plant life. This book certainly goes into the subject with considerable detail, and whether one agrees with all of the author's views or not, it certainly makes interesting reading, and a very copious index and a very excellent bibliography must certainly be included as part of the merits of the book. The illustrations are some of them in color and some plain black and white.

STUDIES IN ELECTRO-PATHOLOGY. By A. White Robertson. Cloth covers, 5¾" x 8½". Publisht by E. P. Dutton & Co., New York.

This is the third book we have had to review, which includes and treats the subject of physiology of plants. It is a very elaborate treatise on the relation of electricity and chemistry to plant life, and we can only say about it—as has been said about another book—that it is too full a treatise to be adequately reviewed here. It includes, however, not only plant life but animal life as well. The action of electricity on plants, electricity in surgery, galvanometric diagnosis, and other advanced topics, are studied from the point of view largely of di-electrics. The author is evidently an admirer of Robert LouisStevenson; a quotation from Stevenson's "Spaewife" precedes the book and the first part is devoted to the lady of the wild, reminding one of "Treasure Island."

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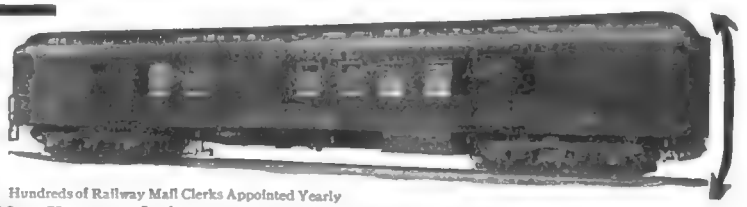

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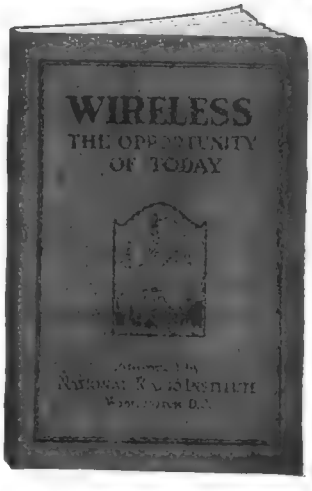

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Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from page 732*)

consisting of 2 parts of acid to 1 part of water. This acid must be prepared in advance and allowed to cool before using.

Now heat the flask gently and collect the gas by upward displacement of air the same

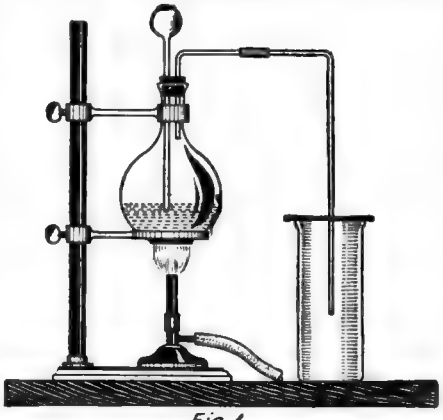

Fig. 1

Chemical Glassware Set Up and Connected, Together With Bunsen Burner for the Preparation of Chlorine.

as chlorine was collected. When the cylinder is full it will fume about the mouth. This is due to the great affinity of the gas for water which causes it to condense water vapor from the air, thus forming little globules of floating aqueous solution of the acid. It will be observed that the gas itself, if collected in a dry cylinder is entirely colorless.

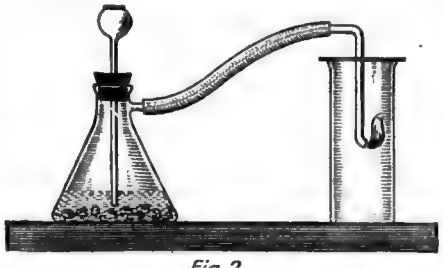

Fig. 2

By Means of This Chemical Apparatus, It Becomes Possible to Burn a Jet of Hydrogen Gas as Shown, in a Glass Jar Containing Chlorine Gas.

When the cylinder is full cover it with a glass plate, and bring the end of the delivery tube just above the surface of about 25 cc. of water placed in a small bottle. Looking thru the water in the bottle toward a good light you will observe an oily appearance. This is due to the settling of the heavy solution of hydrochloric acid, as the gas dissolves in the water. (See Figure 4.)

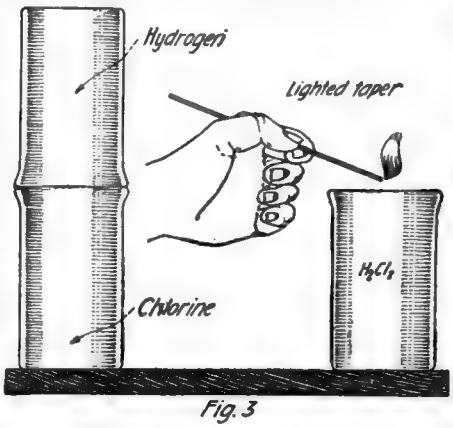

Fig. 3

Hydrogen and Chlorine Gases are Mixed by Placing the Two Glass Jars Containing the Gases Mouth to Mouth as Shown at the Left; the Mixture of the Two May Then be Ignited With a Lighted Taper.

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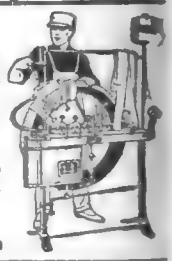

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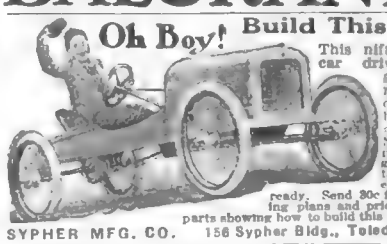

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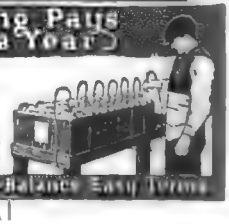

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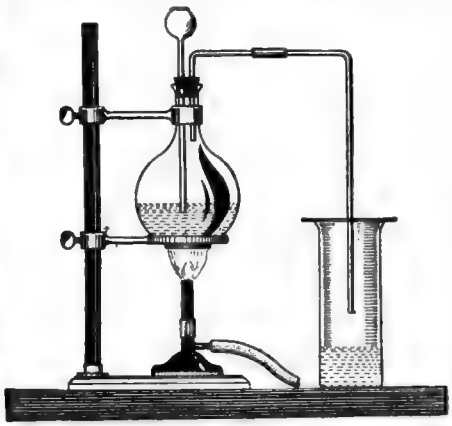

Fig. 4

Preparing a Solution of Hydrochloric Acid is Quite a Simple Matter With the Apparatus Set Up in the Manner Shown.

slight explosion showing that hydrogen has been generated.

Union of Hydrochloric Acid and Ammonia: Fill a cylinder with hydrochloric acid gas and quickly thrust into it a piece of cotton batten saturated with the strongest household ammonia. Immediately re-cover the cylinder and dense white fumes of ammonium chlorid will result.

Generation of Heat by the Solution of the Gas in Water: Fill a dry cylinder with the gas and covering the bulb of a thermometer with a piece of wet filter paper, quickly thrust it into the cylinder. The absorption of the gas by the water will generate enough heat to cause a rise of from 40 to 50 degrees in temperature.

A Fountain in a Vacuum: The apparatus employed is shown in Figure 5. The flask is filled with hydrochloric acid gas by the upward displacement of air before being inverted, being careful to have the flask perfectly dry. A 2-hole rubber stopper carrying a long glass tube drawn out at the upper end into jet-form and also a medicine dropper filled with water is inserted in the neck of the flask. The flask and tube are then inverted with the lower end of the tube dipping beneath the surface of a jar of water colored with blue litmus. By pinching the bulb of the medicine dropper a little water may be injected into the flask which immediately begins to absorb some of the hydrochloric acid gas thereby causing diminished pressure in the flask and drawing water from the jar up the tube. As water from the tube enters the flask it immediately absorbs so much gas as to cause greatly diminished

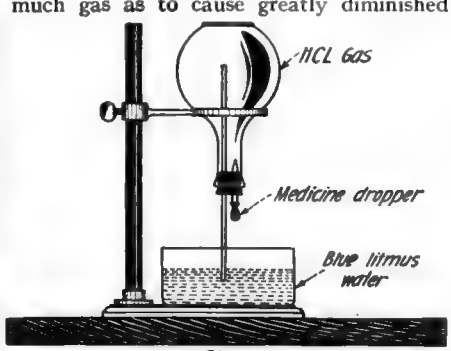

Fig. 5

A Fountain in a Vacuum is Produced With the Arrangement of Apparatus Here Shown. The Flask is Filled With Hydrochloric Acid Gas. A Medicine Dropper Fitted Thru the Cork of the Flask is Filled With Water. The Vessel Below Contains Water Colored With Blue Litmus. Pinching the Pipette Bulb, Water is Squirted into the Flask, Which Causes Some of the Gas to Be Absorbed, Reducing the Pressure in the Flask and Drawing Water up from the Vessel Below.

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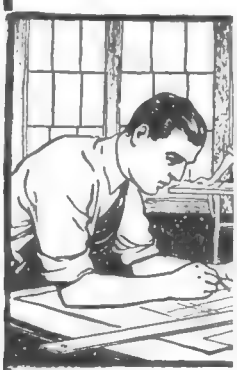

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pressure, and the water then rises with a rush, forming a beautiful fountain. The water, too, turns from blue to red as it enters the flask.

(If ammonia gas is substituted for hydrochloric acid and red litmus water placed in the jar, the color change will be from red to blue.)

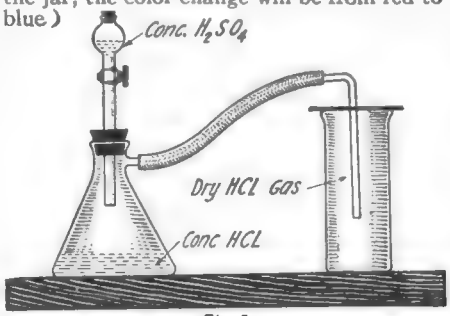

Fig. 6

Dry Hydrochloric Acid Gas is Prepared With the Aid of Concentrated Sulfuric Acid and Concentrated Hydrochloric Acid, Arranged in the Glass Vessels as Shown, the H_2SO_4 Being Allowed to Drop Slowly Into the HCl.

Preparation of Dry Hydrochloric Acid Gas: A very convenient method of preparing the dry gas is illustrated in Figure 6. Concentrated hydrochloric acid is placed in the flask and concentrated sulfuric acid in the dropping funnel. Upon allowing the sulfuric acid to enter the flask a few drops at a time, a continuous flow of the dry gas will be obtained. This method depends upon the great affinity of sulfuric acid for water. It absorbs the water from the solution of hydrochloric acid and liberates the dry gas.

A Convenient Method of Preparing Hydrochloric Acid: Using the same apparatus as that of the previous experiment place in the flask some lumps of ammonium chlorid and in the dropping funnel concentrated sulfuric acid. The acid will react with the ammonium chlorid to generate hydrochloric acid, with the advantage that no heat has to be employed.

Nitric Acid

In many respects nitric acid is the most interesting of the three common acids. It is the most general solvent for metals and it is one of the strongest oxidizing agents known to chemistry. Its salts, too, are a constituent of plant food and of all commercial fertilizers. Because of its great oxidizing power nitric acid is absolutely indispensable in the manufacture of high explosives and modern warfare would be impossible without it. Had it not been for new nitrogen-from-the-air processes of manufacturing this acid, developed just previously to and during the great war, Germany would have been out of commission in the first six months from lack of ammunition. Therefore a knowledge of this acid and its properties is of very great economic interest.

Preparation: The laboratory method of preparing nitric acid, and the only method known until recent years, consists in heating together a mixture of either sodium or potassium nitrate and concentrated sulfuric acid. The apparatus for carrying this out is shown in Figure 7. A tubulated retort with neck and stopper contains the salt and acid, and

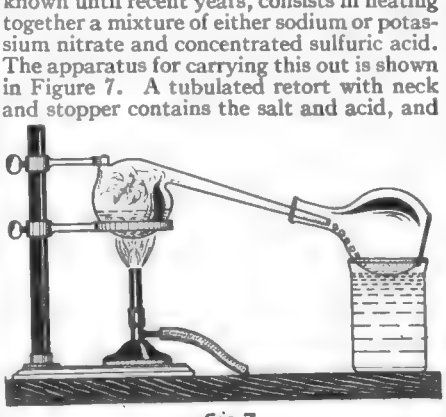

Fig. 7

Preparing Nitric Acid by Heating Together a Mixture of Either Sodium or Potassium Nitrate and Concentrated Sulfuric Acid. A Glass Retort is Used as Shown, the Condensing Flask Being Placed in a Jar of Ice Water.

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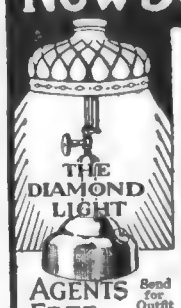

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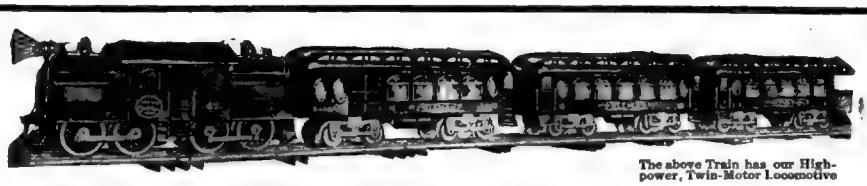
the condensing flask should be placed in a jar of very cold water, ice water if possible. Unlike hydrochloric acid, nitric acid is not a gas but a liquid. Heat the retort very gently and gradually the fumes of nitric acid will appear, and as they pass down the neck of the retort they will be observed to condense on its sides and drop into the flask in liquid form. Altho nitric acid is a colorless liquid, as you prepare it, it will seem to be brown in color, and the retort will fill with dense brown fumes owing to the decomposition of some of the acid by the heat used in its generation. This illustrates the instability of the acid and one of its chief properties.

Experiments with Nitric Acid: Being very careful not to allow any water to enter the flask and mix with the acid, pour a few drops of it on a piece of copper in the bottom of a test tube. You will probably observe no action at all, but add a few drops of water and you will have action a plenty. The copper will rapidly go into solution with the evolution of dense brown fumes of nitrogen peroxid and the generation of considerable quantities of heat. The failure to obtain any action at first is due to the fact that pure 100 per cent nitric acid contains no ions, and until water is added the ionization of the acid cannot occur.

To show the *oxidizing power of nitric acid* place about 2 cc. of the acid that you have just generated in a test tube, and just above it a small wad of excelsior or boiler felt. Upon heating the bottom of the tube in the Bunsen flame, the acid will decompose and set the excelsior or boiler felt on fire.

On a ring stand over a Bunsen burner place a wide mouthed flask and in the bottom of it some sodium or potassium nitrate. Cover this with concentrated sulfuric acid and gently heat. Holding a glowing splint with tongs, thrust it into the escaping fumes of nitric acid, and they will immediately oxidize the splint and cause it to burst into flame.



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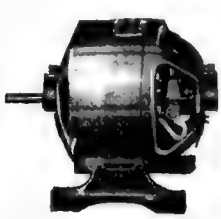

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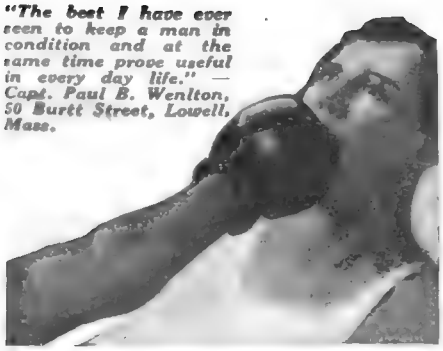

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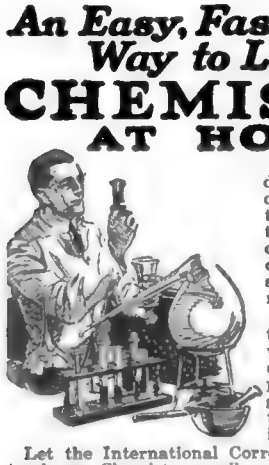

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Combustion of Illuminating Gas: Using the same apparatus as in the preceding experiment, hold in the mouth of the flask a long bent glass tube connected by a piece of rubber tubing to a gas cock. Pass gas thru the tube and upon igniting it, the gas will continue to burn in the atmosphere of nitric acid fumes.

Action of Nitric Acid on Sugar: Place 2 grams of sugar in the bottom of a test tube and over it pour 5 cc. of the acid that you have prepared. In the cold no action occurs, but upon warming, the sugar is oxidized and a violent reaction takes place.

Test for Nitric Acid: In the bottom of a test tube place about 2 cc. of concentrated ferrous sulfate solution that has been freshly prepared. Then inclining the test tube, carefully pour down the side an equal volume of concentrated sulfuric acid. The acid being heavier sinks to the bottom leaving a distinct line of separation between the two liquids. Now pour down the side of the test tube a dilute solution of nitric acid and as it meets the line of division between the two layers a brown ring will form. This test may also be made with any nitrate. If an unknown substance is being tested for, in order to know whether it is the acid and not one of its salts, the litmus test must also be made.

Aqua Regia: The term *aqua regia* means regal water and is the name applied by the old alchemists to the mixture of strong hydrochloric and nitric acids, because they found that this mixture would dissolve gold, the noblest of the metals.

To prepare it mix one volume of concentrated nitric acid with three volumes of concentrated hydrochloric acid and warm the mixture gently. You will observe the upper portion of the test tube to fill with a greenish colored gas. This gas is chlorine and the great solvent power of the mixture is due to the liberation of *nascent* chlorine. The word nascent means "at the instant of birth." At the moment of their liberation elementary gases seem to be much more active chemically than after they have entered into the molecular condition.

If you have any gold pieces to spare try the action of aqua regia upon them.

Action of Nitric Acid on Organic Matter: If you have not already discovered what this action is by bringing the acid in contact with your skin, obtain a large white feather and dip it into some of the strong acid which you have prepared. It is immediately stained a deep yellow. Unfortunately these yellow stains cannot be removed and if you find them upon your hands you must simply wait until they disappear.

Action of Nitric Acid on Metals: Unlike dilute hydrochloric and sulfuric acids, nitric acid does not liberate free hydrogen, when it is acted upon by a metal. This is due to its great oxidizing power. The hydrogen which forms first being a good reducing agent and also in the nascent state reduces the nitric acid with the liberation of a colorless gas called nitric oxid. If you allow this gas to escape into the air you will think that it has a brown color, but this is another gas which has formed by the union of the nitric oxide with the oxygen of the air.

To prepare nitric oxid use the same apparatus that you do in the preparation of hydrogen. Place in the generator copper instead of zinc. Copper rivets or cartridge shells are excellent. Nearly cover them with water and then slowly add concentrated nitric acid. If the action does not start at once be patient. It will be vigorous enough when it does start. When the gas begins to come, collect it over water just as you do hydrogen.

When two or three bottles have been filled note that the gas is colorless and insoluble in water. Now lift one of the bottles from the water and at once the bottle will fill with dense brown fumes of nitrogen peroxid. Thrust the mouth of the bottle back in the water and the water will rise, owing to the solubility of the brown gas.

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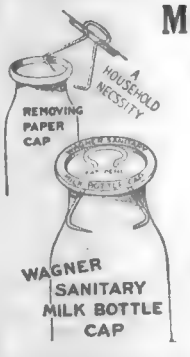

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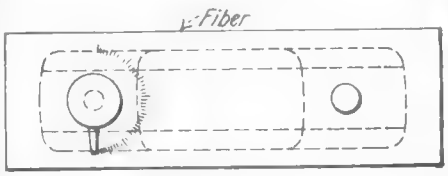
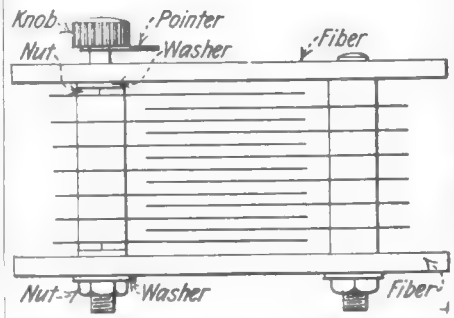
"Razor Blade" Contest Awards

(Continued from page 726)

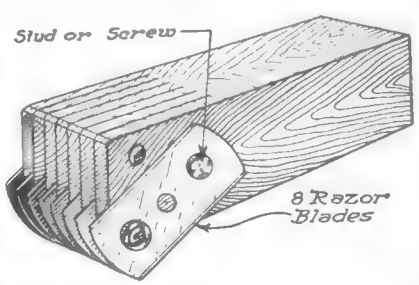
L. Powell, first lieutenant, U. S. A. retired, submitted a host of ideas and models, all of them good. His noodle slicer shown in Fig. 24, is awarded the twentieth honorable mention.

And should you decide to have tender steaks served to you in the future, make wifey one of these meat softeners, shown in Fig. 25, which is awarded the twenty-

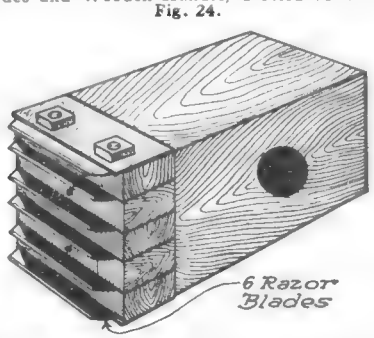




Speaking of Variable Condensers—What's the Matter With This One, Made From a Dozen or so Old Razor Blades? Fig. 23.



Noodle Cutter, Constructed from Old Razor Blades and Wooden Handle, Slotted as Shown. Fig. 24.



Steak Chopper and Dresser Made from Old Razor Blades Clamped on Handle. Fig. 25.

first honorable mention. It is submitted by J. W. Montgomery, of Lawrence, Kansas.

It seems strange that those sections west of the Mississippi contributed the greater amount of ideas. Very few in comparison to the population were furnished by the New England states, and altho a New Yorker walked off with the first prize, second, third and fourth went to Texas, Virginia and Tennessee, respectively.

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Without Residue
By CHARLES S. WOLFE
(*Continued from page* 709)

Davidson grinned grimly, reminiscent. "He was sure mad," he remarked, reflectively, "About the maddest thing that ever stood before this desk."

"You assigned me to the case, and I went around to Grory's. I found that he lived in an ultra-fashionable apartment house. He occupied the fourth floor. I examined the apartment minutely. There were no traces of a forced entrance. My examination of the safe itself was thoro. I feel that I overlooked nothing. And there was no trace of tampering. I did not neglect finger-prints. I found several. Especially on the dials. They all proved to be Grory's.

"I questioned the guards. I am safe in asserting that they were themselves guiltless and that moreover they hadn't an idea of how the job was done. They were patently bewildered. On consideration, the thing seemed impossible. Yet we have to face the twin facts that the letter had disappeared and that Grory most certainly did not extract it himself.

"As I said at the beginning, had it not been for these bizarre features I would have gone no farther. By that time I had had several hours of Grory, and had come to despise him. But I was piqued at my inability to uncover anything.

"Next day, in daylight, I again went over the apartment, finding the first trace of anything of an unusual nature."

Davidson leaned forward. "Ah!" he said, "And what was that?"

"The ceilings in those apartments are unusually high. The lights are in fixtures which are suspended, of course, from those ceilings. They hang so far below the ceilings themselves that when the lights are lit the region above them is in rather heavy shadow. Even in day time the light is none too good. Thinking possibly something of importance might be lurking in that gloom, I secured a tall step-ladder and climbed to scrutinize the ceiling. And I found something which was, in a way, worth climbing for. Directly over the safe, the paper was destroyed in a neat circular spot possibly one foot in diameter. It looked as tho some one had marked out such a circle with a compass and then carefully removed the paper, leaving not so much as a shred of it behind.

"At once I went after finger prints. Nothing doing. Not a mark! Not only no finger prints, but the very dust around that circular spot was undisturbed.

"Baffled, I climbed down. I couldn't account for that spot, but, logically, it pointed still higher. I determined to interview the occupants of the apartment above.'

"Maybe the servants could have accounted for that spot," suggested the Chief, "A fixture removed, something of that sort."

"Of course, I questioned them," replied Joe, patiently, "But they knew nothing about it. Never saw it until I called their attention to it. So I went after the folks on the floor above."

He paused to light another cigarette. Davidson moved about in his chair impatiently. "Yes?" he boomed, "And—?"

"And," resumed Fenner, "Found that the folks on the floor above were the roof. Grory has the top of the house. Well, the roof netted me nothing. No marks, footprints, nothing. Apparently there had been no one up there for weeks.

"So, *pro tem*, I abandoned the spot, and went in search of people with a motive. Off chance, of course, but what else could I do? First and foremost, there was Naida Roner and her husband. She was the one who profited by the disappearance of the

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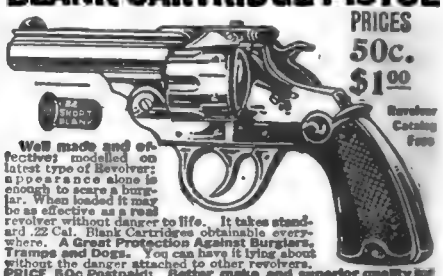

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"She strenuously denied any knowledge of its whereabouts, altho she was openly jubilant over its disappearance. Hubby imprest me as a man who thought he had been benefited by a direct favor of Providence. He is a likeable cuss, but not especially brilliant.

"I learned nothing of any value there, altho Naida, of her own volition, allowed me to search the premises for the missing *billet doux*. But I got an insight into the character of both man and girl.

"Davidson, whatever Naida Roner may have been, and whatever she may have done, I feel that she is playing absolutely straight now. Somewhere, she found sufficient moral strength to throw overboard a barrel of money and marry where her heart lay. The unselfishness of her act proves it sincerity alone, for she gained nothing of a material nature by it. And her husband is just an average American youth, rather better than the set he had been traveling with. What is of interest to us is that neither of them are capable, mentally, of planning or executing the job we are working on."

"You can hire brains," growled Davidson, sagely.

"Sure you can," Fenner admitted, cheerfully, "I didn't say that you couldn't. Well, next I looked up Grory's other wives. Thought it possible one of 'em might have evened up a little personal grudge that way."

"Other wives!" echoed the Chief, blankly.

"Yep—divorced ones. Three—count 'em—three. If Grory had married Naida it would have been no amateur performance. He has a regular pathway worn to the altar. Nothing doing, however. Seems he always picked them for looks, not intelligence. Beauty is only skin deep, they say, but it is evident that Grory is no cannibal. That's deep enough for him. There's not enough brains in the group to get away with this trick. Besides—three splendid alibis.

"Thought by that time that I might just as well look into the other side of the party, and I took to rounding up Naida's cast-off suitors. I went thru the list pretty thoroly, turning up some ten odd, but results were nil.

"After all that work, it occurred to me to do what I should have done in the first place—I took a squint into the apartment below Grory's. I can't see yet why it didn't occur to me that if there was a spot above that safe there might be one below it. There was!

"Or rather, had been. The apartment was vacant—had been, the caretaker tells me, since a week before the letter's disappearance, so I had no trouble getting in. I used the step ladder, and there, on the ceiling just below the safe, I found that some one had mighty carefully repaired just such a spot as I had found on the ceiling of the room above, except that this one had not been more than six or seven inches in diameter.

"The fellow who fixt that spot worked very carefully. He had matched his paper exquisitely, and had I not been looking for a circular spot I believe it would have escaped me altogether. But he did not leave any finger prints.

"I examined all the apartments then right down to the ground floor, but no more circular spots did I find. Then I went after the last occupant of that third floor apartment in earnest. I learned that his name was Livingston."

"Livingston!" echoed Davidson, "Never heard of the brother."

"Oh, I heard of him, alright, within a week after I got on the job. But it's taken me the rest of the sixteen to find him. Believe me, he was the clever little boy at covering a trail. But finally I located him."

"And what did he have to say for himself?" demanded the Chief.

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"Nothing—yet," said Fenner, calmly, "We're going to visit him tonight. I feel that Livingston is the man we want, and—"

"I get you," Davidson was already on his feet, "And I feel quite up to the job. No gent cracks safes in this village and gets by with it—long. Come on."

We piled into the Chief's "Limous," and were presently knocking on the door of a fashionable apartment in the city's best section.

"Wow!" breathed the Chief, as we awaited a reply to our summons, "Don't look like the hang-out of a yegg."

Before Joe could reply, the door opened. A tall, good-looking man of about thirty stood framed in the doorway, questioningly. He was smooth shaven, pleasant faced, and I, for one, rather fancied him from the start.

"Mr. Livingston?" queried Fenner, and, as the man bowed assent, "We have called to see you on rather important business."

"Come in," Livingston led the way into his cozily furnished rooms, and courteously waved us to seats. He glanced at the uniformed Chief, and a humorous smile flickered on his lips, "About Grory and his letter, I suppose," he remarked, calmly, eyeing us keenly.

Davidson's jaw dropt, but Fenner was not at all disconcerted. "Exactly, Mr. Livingston," he replied, with equal calm, "I have an idea that you can throw some light on this exceedingly mysterious affair."

"Yes, I can," the other replied, abruptly, "I was expecting you gentlemen before this. What detained you?"

"Your splendidly executed series of jumps," Fenner said, with candor, "Your technique was perfect."

Livingston laughed. "Sorry to have caused you all the trouble," he said, good-naturedly, "Honestly, I had hoped that the police would never pick up the threads and that the affair would die a natural death. I took pains to assure that end. It seems that I must have missed a point, tho, and here you are."

"You did," Fenner was equally good-natured, "You failed to repair the spot on Grory's ceiling."

Livingston stared. "Heavens," he cried, "Was there a spot there? I did not think—

"Let us start right, gentlemen," he broke off, shortly, "From the beginning. When Naida's engagment to Grory was announced I went to her and did my best to disuade her from the rash act."

"You went?" demanded Davidson. "Why?"

"Miss Roner," responded the man, with dignity, "I had hoped to make my own wife at one time."

"Another suitor!" murmured Davidson, wonderingly, "Their name is legion!"

Livingston flushed, deeply, but kept his temper. "What Naida has been does not count," he said, steadily, "What does count is the fact that there is a world of good in her, down beneath what the world sees. That good I hope to see brought out from now on."

Davidson waved a careless hand. "Your business, Livingston," he replied, "Let me warn you that whatever you say may be used against you."

"I am well aware of that," retorted the other, "And not the least alarmed by the fact. Let me get on. Finally young Burke appeared and did what I had failed to do—aroused a sincere passion in the girl. To my immense satisfaction, she broke with the other beast. You know the result—his threatened breach of promise suit, his silly safe, and the shameful advertising the whole thing got thru the press.

"Naida came, in her distress, to me. To be brief, I promised her that the letter should never be used against her.

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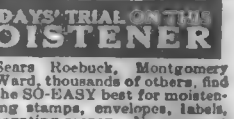

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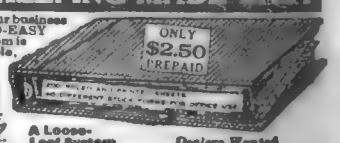

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but of no importance, the letter had been no more in the safe for over a week before Grory chanced to open it."

"You say that you destroyed this letter," began Davidson, heavily, "How did you get it at all?"

Livingston hesitated perceptibly. "The method?" he asked, slowly, "Well, really, gentlemen, I think perhaps we'd better leave the method until later. Fact is," he added, frankly, "I don't believe you'd understand. I'm an engineer and inventor, you know, and the means I took is a matter for experts."

Davidson glanced at Fenner. "Go ahead, brother," he remarked, "It'll be over my head, of course, but this fellow'll get it. Give it to him in x's and y's and the whole rigamarole. He's a nut on it himself."

Livingston looked quickly at Fenner. "Up on electricity at high frequency?" he asked. Fenner nodded.

"Well, then, the truth is that I used something that I stumbled over some time ago while searching for quite another thing. You know that all matter is electrical in the ultimate, don't you?"

"I have thought so," acquiesed Joe.

"Briefly, the atom consists of electrons and positive charges. Have you ever stopt to consider what would happen if an atom was imprest with a nullifying charge?"

Fenner started. After some hesitation, he replied. "Disintegration, I suppose," he said, slowly.

Davidson looked at me helplessly. "Hell, ain't it?" he asked, plaintively, "Are they using the English language, even?"

Livingston, unheeding, continued. "Just that, my friend, disintegration. It would fly apart. Well, passing a cathode ray thru an arc one day, and incidentally thru several other things which I choose to keep to myself, I found that the resulting ray produced a current which just nullified the charges on the atoms of paper. Incidentally, I've never been able to strike the right combination for any other substance. Now you see the length and breadth of the affair. I hired the apartment under Grory's, set up my stuff, shot my ray into his safe, for metal doesn't influence it, and the letter just naturally disappeared—and left no residue.

"Grory jumped to the conclusion that some one had taken it out of the safe, but he was miles away from the truth. The ray, however, is no respecter of paper. All is grist that comes into its mill, and as a consequence, I destroyed a spot on the ceiling over my apparatus. I patched that. I had no idea that the ray was powerful enough to affect the ceiling over the safe. Makes no difference, anyway, for if I had known it, I couldn't have gotten into the apartment to repair it."

"Well, Livingston," Davidson broke in, "You admit you took the letter—"

"No," said Livingston, "I admit that I destroyed it. I didn't take it. I didn't enter Grory's apartment. I didn't touch his safe."

Davidson looked in a baffled way at Fenner. "That's true, Joe," he said, seriously, "He didn't. What charge do we bring against this man?"

Fenner caught Livingston's eye, and winked encouragingly. "Only one that we can bring that I know of, Chief," he replied, slowly.

"What's that?" Davidson demanded, expectantly.

"Malicious mischief," Fenner said, sweetly.

Davidson was a good sport. And he had a heart as big as any other man's. No relaxing of the stern face lines betrayed his weakening, but Fenner and I knew that Livingston had won from his next remark.

"From the way he's been jumping around this city for the past sixteen weeks," he remarked sarcastically, starting toward the door, "I've a notion to make it vagrancy."

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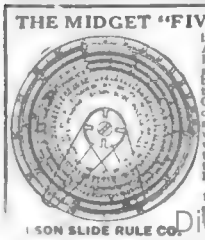

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Editor's Mail Bag

(*Continued from page 729*)

Some say that it is getting to be a juvenile publication, but in my opinion it is interesting to both old and young. Because of the fact that the future lies in the hands of the younger generation, I think that all science publications should contain a reasonable amount of articles suitable for the young people. I think that SCIENCE AND INVENTION is the best magazine of its kind published, and I do not agree with those people who say that it *is traveling on a downward path.*

HERBERT BEKESCHUS.

Houston, Texas.

MORE MAGIC

Editor SCIENCE AND INVENTION:

I have been a reader of your wonderful magazine for the last three years, and believe me, it certainly has grown since. Here's hoping that it will continue as well as it has in the past.

I think that the "Amateur Magician" is one of the finest features published; let's have more of the "magical stunts."

R. J. STEPHENS.

Box 1114,
Shreveport, La.

Sawing a Person in Half

By A. HAZELTON RICE, Jr.

(*Continued from page 733*)

It is not the author's purpose to write an exposé of the act as presented but merely to point out how such an effect could be accomplished.

First, it may be stated that two female assistants, instead of one as supposed, would be required, and while they need not look alike it would be highly essential that the limbs of each be carefully selected for similarity. An examination of the accompanying sketches should make the reason clear.

Victim number one comes upon the stage and is placed in the cabinet, hands, head and feet remaining in full view of the audience. The ends are placed in position and the cabinet given a quarter turn so that the feet face the rear of the stage. Ostensibly this is for the purpose of lowering the cover and locking it, but as soon as the cover is lowered victim number one withdraws her feet and doubles her body into as small a compass as possible, while victim number two, the silent partner, who has been reclining comfortably within the table all this time, substitutes her ankles for those of victim number one. It will thus be seen that the cabinet, which by the way may be made of heavy card board and decorated with an appropriate design, is free to be cut into two equal sections with no danger to its occupant or rather occupants.

After the cabinet is sawed in two the sections, and apparently the victim as well, may be separated by sliding the part which contains the *trunk* and head. It is well to remind the prospective magician, however, that the slides referred to above must be first placed in position and also that any attempt to slide the lower section on the table would result in the more or less sudden disappearance of milady's ankles within the cabinet.

The victim can be "reassembled" by a reversal of the moves already described. Do not, however, forget to first remove the slides or serious complications may arise.

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Automatic Airplane Control

(515) Vernon Harvey, Cameron, Texas, asks: "Would a device permitting an aviator to remove his hands from all controls be practical?"

A. There are quite a few devices on the market at the present day, with which it is claimed an airplane can be controlled while in the air, even tho the operator's hands are removed from all controls. In evidence of this a pilot safely brought his plane to the ground even tho his hands and feet were manacled, a clockwork device being used to turn off the motor and thus allowing him to glide to the earth.

All of these devices, however, are quite inadequate when one has to take into consideration constantly changing air currents, which at any moment might endanger the operator's life.

Gasoline Gage

(515-A) Robert J. Muir, Evanston, Ill., submits a drawing of a gasoline gage which comprises a tube fitted on to the cap of the gasoline tank. The tube contains a column of air. The distal extremity of this tube connects with an airmeter so graduated as to give an indication of the amount of gasoline within the tank.

A. Altho the idea which you have advanced on a gasoline gage is quite ingenious, there are many drawbacks to it. In the first place, you know that air expands when heated and contracts on cooling and, therefore, a very complicated compensation device would have to be added to your gage to take care of the expansion and contraction of the air. You must also remember that this compensation device will have to run alongside of the air tube which passes along the chassis and around the dash leading to the gage, because there are some places where this air tube will be warmer than in others and therefore, the exact ratio must be obtained. A slight leak in the line would make your device inoperative.

Gasoline likewise vaporizes very rapidly when warm and therefore it is possible that a much greater pressure will be obtained in the air tube due to the vaporization of said gasoline, giving a false reading. Because of these many drawbacks, we would hesitate at advising a patent upon this idea.

Spring Motor Fan

(516) H. Matsuo, New York City, asks:

Q. 1. Please give me number of patent on spring motor for fans. Has one been built?

A. 1. A spring motor for fans has been built, but it is not successful, evidence of which is the fact that very few of these motors are to be found upon the market. We do not know the patent number off hand, but believe that in order to locate patents upon this particular subject, you should have a search made in the patent office.

Incendiary Bomb

(517) L. Manescan, Shawinigan Falls, asks our advice on an incendiary bomb.

A. The description of this is not complete enough to warrant our giving a very accurate analysis. We would, therefore, advise that you furnish us with more details.

Machine Gun

(518) Henry Nelson, Eau Claire, Wis., says, "I have an idea of a machine gun. This is to take cartridges from a box and automatically feed them to the gun. Please advise."

A. In view of the lack of details we are unable to give definite information. We do not believe, however, that the idea which you have evolved will warrant patenting in view of the fact that several generations may pass before we enter upon another war, and perhaps years and years would then be spent in order to get the Government to recognize the practicability of such a device, during which time there is no financial return.

Monkey Wrench

(519) Oscar H. Ochik, Torrington, Conn., submits a design of a monkey wrench with sliding jaw.

A. Altho the design for a monkey wrench which you have submitted differs [illegible] from patented wrenches, we doubt very much whether you will be able to find a commercial field for such a device.

There are on the market at the present time, ratchet money wrenches, in which it is only necessary to place one jaw in contact with the bolt. By applying force, the jaws of the wrench close automatically and grip tighter with greater pressure. With this device, it is only necessary to turn the wrench in the opposite direction, holding the nut in one position, and the wrench opens to its fullest extent. Such a wrench, we believe, is far superior to yours.

In order that a patent be of real practical value, it must be made so that it will sell. We cannot foresee such a sales value for your device and, therefore, we hesitate in advising a patent upon it.

Perpetual Motion Again

(520) S. P. Nair, Boston, Mass., submits a diagram of a perpetual motion machine in which water drives several turbines, the water to be again returned by means of pumps.

A. The idea advanced is not new at all, and it will not work for many reasons. In this system you have two turbine generators which are supposed to drive the electric motor-pumps indirectly thru storage batteries, these two turbine generators, acted upon by water give about 78 per cent efficiency. When this energy enters the storage battery you will have about 58% of the original energy stored up. This can again be converted into work by the motor turbine pumps which will reduce the efficiency of the entire apparatus about 35%. In other words, you will get about 35% of the water in the top reservoir, which is needed for the successful operation of the contrivance and it will only work until all the water flows out of this reservoir.

Patent License Contracts

(521) William J. Peltz, Newark, N. J., asks why certain articles become public property, while others remain in the possession of one company alone, citing the case of a concern who have a patent top to a tooth paste tube which they manufacture.

A. A man who has a patent on a device, can request as many manufacturers to make this device as possible, provided he has not made an exclusive contract with anyone of them. Thus, if this company were receiving their tubes from some concern who manufacture tubes solely, they have no right to claim the exclusive use of such a tube, unless of course, they have a contract with the manufacturing concern, stating that they alone can use such a tube.

It depends entirely on the inventor or the one who is handling the invention, as to whether or not the device will be made only by one concern, or by a number of concerns.

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Swimming Belt

(522) Donald Parker, Ontario, Oregon, says he makes swimming belts of automobile tubes, cut down and vulcanized together making the ring, or belt, just large enough to fit the wearer.

A. Whether or not the particular swimming device which has been the subject of a recent article publisht in our magazine is identical with yours is not definitely known, in that our knowledge of the other device is merely superficial, but you will have noticed that we have described a swimming device so similar to a life preserver made from an inner tube of an automobile tire, in one of our past issues that we doubt the patentability of your scheme.

Wood Preservative

(523) L. E. Reed, Orwigsburg, Pa., suggests the invention of a liquid preparation that would petrify or at least harden wood, and so aid the effort to save our forests.

A. Chemists know how to prevent wood from rotting and as a matter of fact there are quite a few concerns which are specializing today in impregnating railroad ties with a compound (creasote, etc.), which prevents tie rotting to a very great extent. These solutions are so efficiently applied, that in some instances they penetrate three inches or more of wood. If you have a new cheap means to petrify wood, it certainly would prove a money maker.

Razor Blade Device

(524) Ernest A. Rerucha, Milwaukee, Wis., presents an idea for utilizing safety razor blades. It is a pencil sharpener with the blades set in a suitable frame, in such a way that when dull they can be removed and new ones put in their place.

A. The idea of a pencil sharpener utilizing safety razor blades is very practical, and we would advise that you have a model built of this device, improve on it if thought necessary, and proceed with patenting the same.

A device of this nature generally finds a very ready market, particularly in view of the fact that the blades are renewable. Altho there are safety razor blade sharpeners on the market, there is none similar to your device.

Twin Electric Receptacle

(525) Claude F. Stone, Lebanon, Kansas, says that having seen the need for a bracket lamp into which one may "plug" for appliances or portables without the necessity of removing the shade, he has invented such an article and asks the possibility of obtaining a patent on same.

A. It is quite possible that you could obtain a patent on the twin socket alteration which you have devised, but we do not advise that you use already patented articles in the manufacture of the same.

Why not redesign the entire outfit so as to make it look much neater, and at the same time answer the purpose.

The canopy switch which you use to control the light should be so arranged that it can also control the attachment, or if desired two canopy switches may be inserted into the base of the device for this purpose.

We would advise that you have a search made, and see whether or not your claims for a patent will be clear.

Auxiliary Ignition Battery

(526) Herman Rinkenberger, Bradford, Ill., says he has a sheet metal case that will hold a 4-cell battery. It has braces made to bolt on to a farm tractor under the coil-box. He desires patent advice

A. You have not devised anything new. Substituting a battery for a magneto to assist in starting a tractor, or a gas engine of any kind whatever, is a very old device, and has been employed time and again, and is today in general use in most of the larger automobiles.

Talking Movies

(527) Michael Russo, says that he has conceived a new method of producing the "talking-movie" by means of a phonographic attachment which could be placed on the machine in such a position as to have a needle run in a specified groove on the edge of the film, but due to lack of scientific knowledge is unable to find a suitable material for the material carrying the groove.

A. We believe that if you find the proper material in which to make the groove, you will have a very good film for talking motion pictures, but the main question is—find the material; we doubt whether you can ever locate such. This must be flexible, rugged, capable of being cemented together and when cemented must not dislodge the needle.

Freak Movies

(528) Charles F. Taylor, Fortuna, Cal., has conceived of the idea of providing a concave or convex screen either of polished steel or a mirror. A means by which this screen can be turned with its convex side to the audience, or vice versa, thus causing the same distortion of the figures as shown in the "Coney Island" mirrors is also included.

A. We do not believe that your idea is practical, for the simple reason that by projecting the moving pictures thru a prism, or an extra lens, the same result could be obtained without necessitating such a costly installation as you have suggested.

(*Continued on page* 781)

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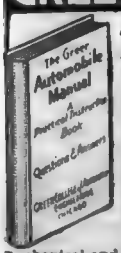

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Home Electrics

By G. L. HOADLEY, M.E.

(*Continued from page* 730)

When a fuse has blown, in order to determine whether a circuit is *shorted* or *grounded*, proceed to the *cut-out box*, open the switch and replace the blown fuse with a lamp; then close the switch. If the lamp lights up it will indicate there is either a *short* or a *ground* on the house circuit. If the lamp does not light a new fuse may be used to replace the lamp without likelihood of its being blown when the switch is closed. Suppose the lamp does light, indicating trouble. To determine whether it is a *short* or a *ground* which exists on circuit A, Fig. 6, remove both of the fuses and screw a lamp into the outer wire of a three-wire circuit, as indicated in Fig. 6. Then put a screw driver or wire directly across the terminals of the *house circuit*. Current will then flow when the switch is closed thru lamp or screw driver or wire to outer wire of house circuit, and up thru circuit to fixture wires, and thence down to grounded fixture, and thence back to neutral wire, thus lighting the lamp in "a," showing that a ground exists. A *short* would not light the lamp because the fuse in the other side of the circuit is out and there is an open circuit in this wire, so that no current can flow. The place where the *ground* is located can best be determined by disconnecting the leads to first one fixture and then another, until the lamp in "a", Fig. 6, no longer lights. If the furthermost fixture is disconnected first and one then works back along the circuit to the trouble, it will usually be located most easily.

Where a telephone receiver is available, coupled with one dry cell, it may be used very effectively to determine *shorts* and *grounds*. In order to test with the telephone receiver for *shorts*, remove both fuses of the house circuit V, and connect the battery and receiver shown in Fig. 7 in series directly across the house circuit wires at c and d. Current will then flow out from battery thru circuit B to the *short*, over it, and back thru telephone receiver, producing a sharp click in it. No click would indicate the line is clear and no *short* present.

To test for *grounds*, remove both fuses of house circuit B and put the battery and receiver in series as before. Ground one side by connecting one terminal to a water pipe if possible, or to a gas pipe, or to a conduit. Connect the other terminal to first one wire, then the other wire in turn. If a ground exists a sharp click will be heard. An ordinary bell and battery can also be used for making these tests, as outlined in Fig. 8.

Fortunes from Little Things

By CHARLES FREDERICK CARTER

(*Continued from page* 724)

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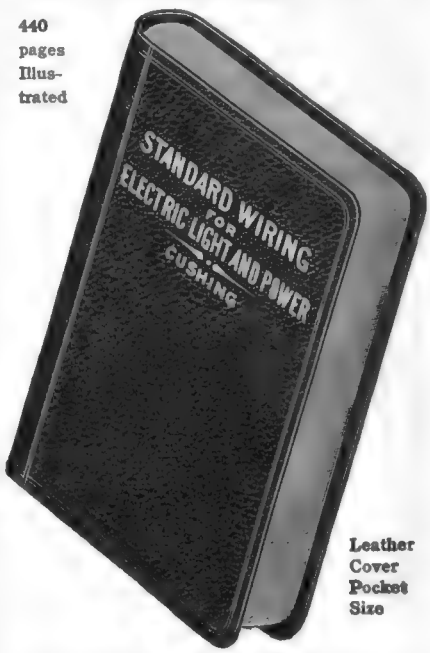

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Electric Power from Earth's Heat

By C. S. CORRIGAN, C.E.

(*Continued from page* 715)

gripping it; pumps collect the cuttings from the saws into a tank, so all the material cut loose is lifted to the surface by the machine; a refrigeration tank with liquid air controlled by a thermostat is provided to keep the machine cool.

Realizing that it would be necessary to excavate a large underground boiler or room to radiate heat fast enough to turn large amounts of water into steam, I have also designed the underground tank machine illustrated. It consists of long stone-cutting chain-saws operated by motors, the frames of the saws being controlled by worm-gear arrangement to push the saws into the sides of the well and cut loose large portions, that drop to the bottom, so that the core-lifting machine can enclose and lift them to the surface. It may be said that the walls of such a room would cave in; if so the debris may be lifted to the surface in the same manner; the core lifted to the surface when first making the well would show the exact formation so a suitable location could be selected before starting the room.

When a well has been sawed deep enough (about 5 miles), to find 1000° Fah., temperature, and an underground boiler constructed large enough to accumulate heat fast enough to furnish the desired H. P. of steam at, say 500 lb. pressure, to operate a large turbo-generator, the electric power plant would be installed. The upper part of the well, in fact all of it in stratified or disturbed rock, would have to be lined with steel pipe, cemented to the walls of the well, to prevent steam from leaking away. The proper amount of water could be conducted to the bottom thru a pipe line attached to a sustaining cable, distilled water should be used to avoid encrusting the walls of the underground boiler, and a condenser provided to recondense the steam after being used in the turbine so the same pure water could be used over and over again.

Turning the water into steam would reduce the temperature of the underground boiler walls from 1000° F. to 800° F. or some point at which the heat required to maintain 500 lb. pressure would radiate into the boiler as fast as used. Part of the 800° F. heat would then act to superheat the steam, so that the underground boiler temperature would be reduced to, say 700° F. or some degree at which heat was received as fast as used for both producing and superheating the steam. When desiring to operate the turbo-generator at part load, less water would be furnished the underground boiler and the superheat would increase as the amount of steam decreased; to stop the turbo-generator, the water would be entirely shut off and the underground boiler temperature would again rise to 1000° F.

There being no consumption of fuel or other supplies except oil and attendance and the first cost of a large power plant being less than the cost of a similar plant today, electricity would be produced so cheaply that Interior Heat Power Plants, capable of producing ten times the horsepower now required, would be installed in every town and city, not only in this country but all over the world, and there would be such an increase in the invention and use of labor saving machinery as man has never dreamt of. Then no scientist would say "use sparingly," for there is heat enough in the interior of the Earth to last us all a billion years.

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Oddities of 1,000,000 Volt Transmission

(*Continued from page 704*)

could be overcome by increasing the diameters of the wires at high altitudes until they included the corona, and increasing the spacing between wires, but as yet the altitudes encountered and the voltages used have not made this necessary, and the diameters of the cable remains the same thruout the line.

Fig. 4 shows three important phases of 1,000,000 volt transmission and why the corona loss at such high voltages is a factor to be reckoned with. Electricity always tends to leak off pointed electrodes or small wires, much more easily than from conductors of larger diameters or spheres. In the experiments carried out at Pittsfield, brass tubing about 4" in diameter was employed, but when it comes to building a transmission line, such tubes would not be suitable from a mechanical point of view, and it has been suggested that undoubtedly stranded or woven hollow copper conductors will serve the purpose very well indeed, placing a steel cable or wire inside the woven conductor to help support it. To keep the corona loss within practical limits, the woven or stranded conductor will undoubtedly have to be made at least 4" in diameter.

Mr. Rushmore, the engineer already quoted, has stated that, figuring on the usual basis of 1,000 volts per mile, a 1,000,000 volt line should transmit electrical energy for a distance of 1,000 miles. The accompanying map, Fig. 5, shows what a tremendous area a circle of 1,000 miles radius would cover, considering for the moment that a gigantic power station was erected at Niagara Falls, capable of utilizing all of the latent horsepower in these wonderful falls.

Tesla Air-friction Speed Indicator

(*Continued from page 722*)

In a later patent Dr. Tesla covers a scheme for using mercury instead of air between the cups or disks, in order to give a more pronounced and reliable scale reading or deflection of the pivoted secondary member, when the instrument is to be calibrated for low speeds. One of the remarkable outstanding features of the new Tesla speed indicator is the fact that the scale divisions are all of equal size, thus making the instrument much easier to read and also much simpler in its calibration. In calibrating, it is simply necessary to adjust the correcting or biasing spring, until the needle just reaches the upper part of the dial when the upper limit of speed to which the instrument is to be adapted is reached; it is then a simple matter to divide up the scale into equal divisions and to evaluate each division or group of divisions. The action of the apparatus is almost uncanny to the uninitiated, but the fact that the instrument has now been brought out commercially proves that it will do the work claimed for it, and that Dr. Tesla's theory and ideas as explained in his patents covering the device are correct.

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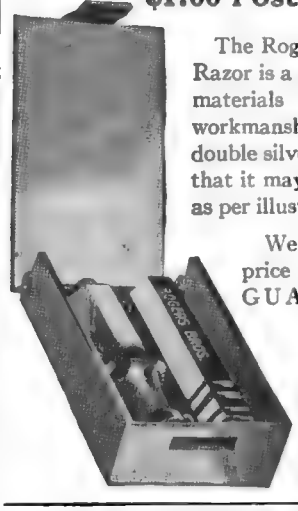

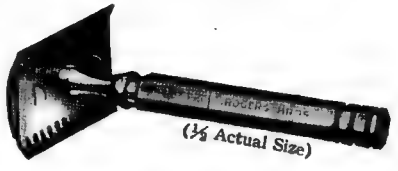

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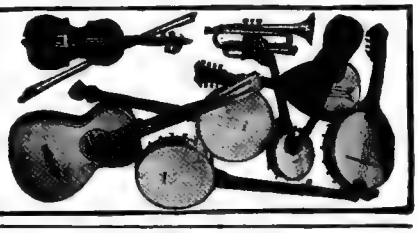

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Compressed Air-Driven Model Monoplane

By WILLIAM J. BEACH

(*Continued from page 736*)

ens same and adds to the appearance. The under carriage is made from two thin pieces of wood having weight-reducing holes and slots to receive the axle, which is retained at the bottom of the slots by fine round rubber cord, which acts as a shock absorber when landing. A stream line tail skid is secured in the position shown.

The stabilizers are made up of a framework construction, while the rudder and elevators may be made from the solid, and since they are stream line in shape, their weight is negligible. The scalloped effect shown may easily be carried out along these lines. A piece of silk glued on top and bottom of the joint and extending the full length thereof, makes an admirable hinge for the rudders and elevators. The vertical stabilizer is provided with two pins as shown in Fig. 4; these are embedded in the top of the body while the entire tail-unit is held firmly in place by two fine cords, as illustrated in Fig. 1. Control lines are led away from the rudder and elevators and pass thru a small hole in the body, where they are held in any desired position by a tapered peg forced into the hole. The wing-construction is clearly illustrated in Fig. 2. The scalloped effect is accomplished by stretching a fine cord along the trailing end of the ribs, which undulates after the covering has been placed on the wing frame and will shrink, due to the airplane *dope*, which must be applied to the surface.

Fig. 5 shows the method of preparing a rib while the spars are cut so that one receives the other. The wings are held in place by stream line struts as appears in the various views. It is essential that any model airplane must be in a perfect state of balance. This is best accomplisht by carrying out a series of gliding flights to ascertain the correct location for the wings. One hundred and fifty to one hundred and eighty pounds per square inch air pressure in the tank is necessary to obtain the best flying results with this model.

Insects as Jewelry

By Dr. ERNEST BADE

(*Continued from page 703*)

The electroplating solution consists of gold fulminate and potassium cyanid. To each liter of water 1¾ gr. of the fulminate and 16 gr. of the cyanid are added. When this has dissolved, a piece of clean gold is used at the positive pole and the beetle attached to a long piece of copper wire is used as the negative pole. This is left for a few hours until the deposit of gold is thick enough, then washed, and attached to pin or brooch.

The above process is the best altho the longest. If it is desired to give the beetle a slight deposit of metallic silver, it need only be dipt into a dilute solution of potassium cyanid, after it has been covered with silver sulfid. Care must be taken that the silver does not scale off.

Gold beaters' gold-leaf or other foil can also be used to advantage if the animal is first covered with a suitable varnish. From these processes it is but a step to the cheapest, easiest but by no means the best nor the most suitable process, and it is only mentioned as a last resort, and this is varnishing or painting the beetle with metallic paint.

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Impact Process of Making Gasoline

By D. C. MINER

(*Continued from page* 717)

As made by the process now prevailing in the industry, gasoline is a result of distillation from crude oil, 11 barrels of kerosene being obtained to one barrel of gasoline. Kerosene cannot be so readily marketed as gasoline; and the large oil companies have given away lamps in foreign markets just to stimulate the use of kerosene, a less volatile product of petroleum, but necessarily taken off in the old process of making gasoline. The heat process is costly, slow and wasteful, involving considerable danger to operatives.

The Emerson process is a *cold* process and no sulfuric acid, soda treatment, is employed. It is rapid and economical. Its use not only means an increased supply, the inventor claims, but would make the product cheaper and better.

The rapidity of the conversion of fuel oil, or gas oil, into this remarkably pure motor fuel is indicated by the output of the large battery of *units* recently installed at a Texan oil center. Three gallons per minute per unit was the maximum performance altho the expectation was one barrel per hour per unit.

To the experimental plant in Philadelphia visits are paid daily by the automobile agencies who fill up their tanks with the new gasoline before going out to demonstrate a car. The added *kick* and the fact that no carbon is left in the cylinders gives a car a smooth running ability and a *get-away* in traffic that makes the machine seem that much more desirable to the prospective purchaser.

Preliminary tests of the oils of some of the big producers for adaptability to the process, is made at the Philadelphia plant. The oil company is invited to take charge of a 24-hour run on their own product, observe the process, keep time, check quality by the hydrometer for gravity, and other familiar instruments for volatility.

To Mr. Emerson there falls the distinction of having accomplished what German chemists have striven for years to do—invent an apparatus that yields pure gasoline from fuel oil and which mayhap will revolutionize the production of gasoline thruout the world.

In telling of his invention, Mr. Emerson dwelt on the possibilities of it to the scientific world. If the force of impact will break down fuel oil into a nascent state, why can it not be used for destroying chemical affinity of other kinds of matter he argues.

Time Switch for Electric Heater

(*Continued from page* 738)

the wire from terminal F, the circuit is completed thru the electro-magnet in series with the heater coil, thus causing the armature of the magnet to close the little knife-switch mounted on a small block of wood B, at C.

When this switch closes, it puts the heater coil in parallel with the 110 volt circuit, and a little later, the hand on the clock passes on and opens the circuit of the magnet coils.

The alarm clock and magnet can, of course, be placed in the most convenient part of the room, and the heater elsewhere, if desired—according to the length of wire used.

Contributed by ALEXANDER WALKER.

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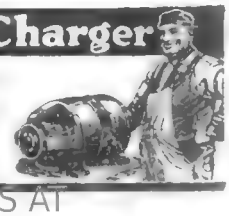

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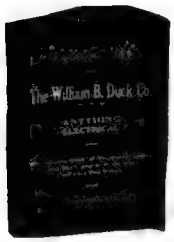

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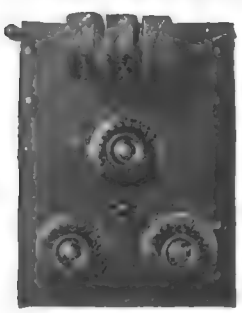

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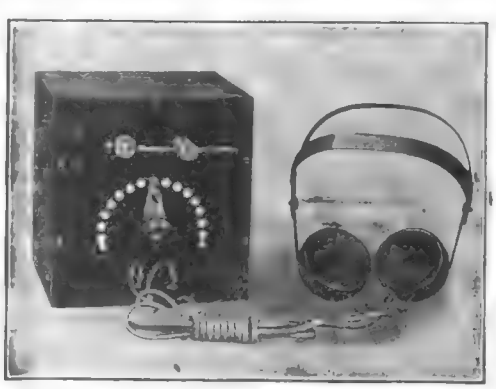

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A Short Wave Regenerative Set

By WILLIAM H. GRACE, Jr.

(*Continued from page* 740)

tube, with 18 turns per section. After all the winding process has been accomplished the coils are coated with a very thin layer of shellac. The idea is to keep the distributed capacity at a minimum.

ANTENNA CONDENSER

Altho there has been considerable discussion relative to the use of this instrument, I believe it is not only a decided advantage in improving the selectivity of the set, but also its general operating efficiency; the vacuum tube being a voltage-operated device. The condenser used was of .001 M. F., capacity, quite unique in its construction, consisting of a metallic plate, separated by a thin sheet of mica from a chamber of mercury. Change of capacity is made by rotation of the entire unit. Any type of condenser having about this capacity may, however, be used.

ASSEMBLY

The variometers and loose coupler are assembled as in Fig. 3 which shown the coils mounted on the No. 8-32 machine bolts. This arrangement, tho simple, has with the proper adjustment of nuts and washers, given complete satisfaction and is much less complicated than most methods now in vogue. The variometer coils are connected in series, and the flexible leads are brought thru the holes as per cut in Fig. 3. The plate variometer is then connected to the two lower binding posts in the right-hand end of the panel. The grid variometer is connected in series with the coupler secondary and thence to the two upper binding posts at the same end of the panel as the plate variometer. The primary switch arrangement is self-evident from the illustration and the contact points are amply separated to keep the capacity effect practically nil.

The constructor may wonder at all the fuss to eliminate capacity, but this is a very important factor in the efficient operation of this set. The taps from the primary are brought to their respective contacts—6th to No. 1, 18th to No. 2 and 30th to No. 3. The end of the primary winding nearest the tap is brought to the binding post marked Aerial and the connection from the switch itself is brought to the Ground post. The condenser terminals are brought out separately so that the condenser may be connected in either series or shunt.—Series for short waves; and shunt for about 400 meters or above. The secondary can be shunted by another condenser for 600 meters. The lay-out of the rest of the set is self-explanatory, so space will not be wasted in details.

OPERATION OF SET

This set will operate on amateur wave lengths. It has a high degree of efficiency and selectivity seldom found in commercial instruments, and if properly adjusted, will give absolute satisfaction. First, set all controls at zero and then tune the primary condenser and secondary variometer with the primary switch on the contact of the 18th turn (this was correct on my aerial); then lastly, adjust the plate variometer and 'phone condenser. This condenser is a great help in controlling the plate circuit for fine adjustment and acts as a by-pass for H.F. currents. Of course to pick up stations tight coupling should be used.

The writer used knobs and pointers because of personal preference, but the modern dial indicators can, of course, be used instead.

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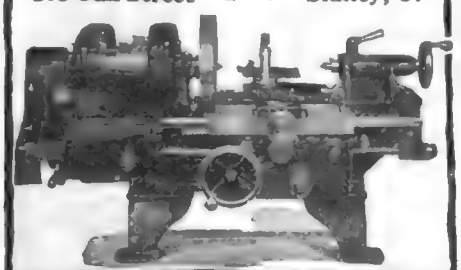

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Science & Invention, published monthly at New York, N. Y., for Oct. 1, 1921. State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of the Science and Invention, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Pub'g Co., 233 Fulton St., New York City; editor, Hugo Gernsback, 233 Fulton St., New York City; managing editor, Harry Winfield Secor, 233 Fulton St., New York City; business manager, R. W. DeMott, 233 Fulton St., New York City. 2. That the owners are: Experimenter Pub'g Co., Hugo Gernsback, Sidney Gernsback, H. Winfield Secor, R. W. DeMott, Dr. T. O'Conor Sloane, Mrs. Catherine Major. (All of the above of 233 Fulton St., New York City). M. M. Finucan, Hartford Bldg., Chicago, Illinois. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders, who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. 5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ——. (This information is required from daily publications only.)

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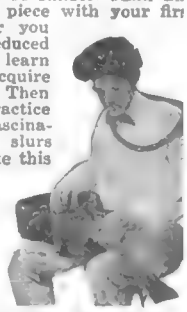

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DE FOREST

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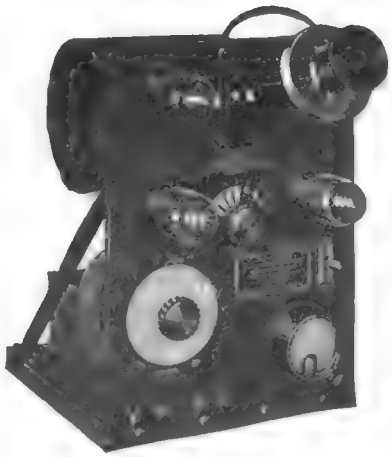

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Entire transmitter, including batteries, weighs less than 60 pounds.

Range on ordinary amateur serial is 5 to 10 miles; can be materially exceeded under proper conditions. Operates with a suitable Receiver and Audion Detector; with or without Audion Amplifier, depending on the range to be covered and loudness of reception desired.

without storage batteries
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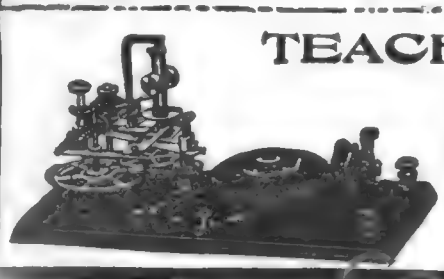

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The Physiology of the Leaf

By JEAN CAMPS CAMPINS

(*Continued from page* 721)

To understand this process of assimilation more clearly the internal structure of the leaf must be examined. Fig. 5 shows a very minute cube cut off from the leaf of a bean plant; D—the under skin (epidermis), D—the upper epidermis, A—stomata; (note the cellular structure of the epidermis and the stomata thereon); E—central leaf tissue which is divided into two layers; B—the upper tissue (palisade tissue) of elongated compact cells (notice the chloroplasts in them, appearing as dots in the picture; they are thus compact to absorb as much light as possible; the stoma leading to large air spaces, and the spongy tissue with its numerous air spaces to permit free interchange of gases); G, H and F are the conducting tissues, one portion of which consists of tubes (wood vessels) which bring the crude sap to the leaf; and another portion of tubes which carry off the sap elaborated by the leaf.

When the leaf is exposed to sunlight the first product is usually *cane sugar,* but this is converted into starch as a means of temporary storage; so starch usually appears as the first visible product and its place of location is in the chloroplast.

Testing of Gas Appliances and Auto Wheels

(*Continued from page* 717)

and the observer is occupied with one investigation out of many others carried on in this department.

The other illustration shows the testing of automobile wheels. The mass of machinery shown is designed to put various strains upon them, so that it can be determined whether they will stand up when they are subject to the trying stresses of the road. Airplane wheels are also fully tested, for when an airplane comes to earth the wheels are subject to various severe strains, and the wreckage of a wheel might involve the overturning of the plane and injury or death of the occupants.—S. R. Winter.

Bores Hole Lengthwise Thru Pin

(*Continued from page* 720)

clean thru the head to the center of that atom of space, the point of a pin. William Humans, an expert-watchmaker, of Cambridge, Mass., has performed this unusual feat, as the photo shows. He has the pin now, with a wire running thru the hole, as a proof of his skill.

ELECTRIC TOOTH-BRUSH MAKES DEBUT

A new article that is of interest to every human being is the electrical tooth cleaner and polisher that has the same essential scientific principles as used in the dental profession, yet so arranged that the novice or individual in the home by the turn of a switch, can have at his command the same service every day, that, in the past, the dentist gave us but once a year. The photo shows how the brush can be applied, and the additional brush parts which can be changed to suit the user.

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Patent Advice

(*Continued from page 772*)

Hymns of Hate Up to Date

(*Manufacturers in All Towns Please Copy*)

The neat glass jar
With a mummy case seal
Is a thing to hate
With fanatic zeal.
"Insert a fork and
The rubber pulls out,"
Is a fairy tale
Beyond all doubt.

But the thing that I hate
The very worst
Is the sardine can we
All have cursed.
Just try the old key; you
Soon will learn
That it always breaks on the
Second turn!

On the pantry shelf
What stirs my gall
Is the bottle that's large
With a neck too small.
Grand thick dressing
Lies safe inside,
And to coax it out
I can't abide.
I shake and shake
And poke and blow
But thru the neck
Will no foodstuff flow.

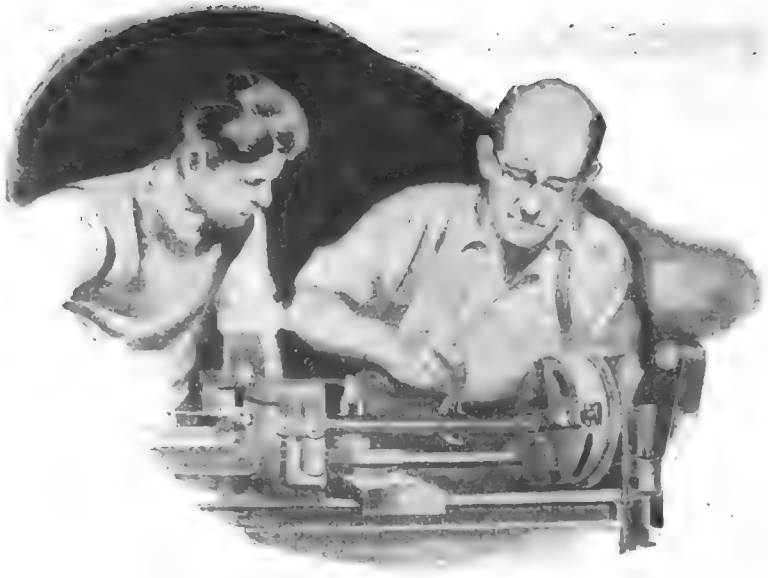
Gee! how it does stir
Up my ire
When I grab a fine saucepan
Off the fire,
To find that the flames themselves
Aren't hot
Compared to the handle of that
Goldurned pot.
The thing that makes me
Full of spleen
Is a certain cream jug
I have seen.
You pour just as well as
You are able,
And the first thing you know
It's dripped on the table!

The thing I hate is an
Old teapot,
That once—worse luck!—fell to my
lot.
When you turn it up, watch out
For the top,
Or into your tea it will
Fall ker-flop!

(It is not often that the inventor gets hints in rhyme. We pluck the above from the New York Tribune, and we may be sure that when a poet is compelled to spill such poetical tears of sorrow, everyone in the country will be crying with him—or perhaps, cursing. Is it not up to our inventors to find remedies for the nuisances described so adequately in rhyme above?—Editor.)

ITALIAN SCIENTIST DIGS NEW HOLE IN NEWTON THEORY

Prof. Barricelli has made an important scientific discovery which, it is said, largely modifies the Newton and Laplace theories. After long study with his own apparatus Prof. Barricelli discovered that the gravitation of the terrestrial surface was subject to great local modifications, this being partly determined through external causes. Sometimes the modifications were unexpected, such as the relations of the tides. The most important factor in his discovery consists of the electrical influence on gravitation, which may be inserted during a hurricane.



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The World's Series by Radiophone

By ARTHUR H. LYNCH

(*Continued from page 739*)

the loud speaker was used on the twelfth floor, where it spent part of its time in a room and part of its time in the hall, near the elevators. The elevator operators spent most of their time on the floor, where the game was being reported.

The Claridge is very popular among out-of-town shoe buyers and many of them, who could not get to the game, came up and introduced themselves and readily accepted the invitation to remain.

We did a few things which are not generally attempted. For instance, the room, where the set was installed, is on the twelfth floor and the first day the set was put in operation the only aerial used was a short piece of wire thrown out of the window, while the ground side of the receiver was connected to a steam radiator. Very good results were obtained. The next day a wire was run up to the roof and this gave even better results and the signals could be heard all over the room. Then a flag pole was spied, on another building, about one hundred feet distant, and its top was directly opposite the window, so a wire was run up by the flag halyard and brought to the window. Signals just piled in, when this aerial was used.

The Claridge is four blocks from the Intercity Radio Station, which operates with Detroit and Buffalo, and this station has the reputation of causing a lot of interference in this district, but we were able to receive the speech with absolutely no interference. By using the two aerials, one for an aerial and the other for a ground, it was possible to eliminate any interference, which was experienced from vessels operating on six hundred meters, tho some of them were equipt with powerful transmitters and were less than a mile from us.

The aerials were at right angles to each other. The signals were very loud and we tried out several types of loud speakers. The one which gave the greatest satisfaction did not require any battery to operate it and was directly connected to the output circuit of the receiving set.

It is doubtful if the method used for operating the loud speaker has been employed before, so we may well consider it. A single wire was run from the output circuit of the receiving set, which was in the room on the twelfth floor, to the loud speaker which was installed in the lobby on the ground floor. The remaining terminal on the output circuit of the receiver was *grounded* and the remaining terminal of the loud speaker was similarly *grounded*, an unusual radio circuit. The receiving set used was one comprising a vacuum tube detector and two-stage amplifier unit, in the same cabinet as the set. From the performance of this set, any misgivings I may have previously held concerning the effective tuning of a single circuit receiver have been dispelled, for it was very sharp. With no amplification the voice could be heard all over the room, which was not a small-sized one, while it was only necessary to use two stages to fill the entire lobby, from the set twelve floors above, without adding any additional strain to the storage battery. Radiotrons were found to be entirely satisfactory for detector and amplifier tubes, tho a supply of more expensive tubes were on hand, which were found to be inferior. Dry batteries were used for the plate circuits and the voltage supplied the detector was 22½, while 45 volts were supplied to both stages of the amplifier. *Photos Courtesy Manhattan Electrical Supply Company.*

Amateurs Make the Best Commercial Operators

THAT is the expressed opinion of the two men who do the actual hiring and firing of over ⅔ of the operators employed in the Port of New York. The radio amateur who is also a radio school graduate is rated by them as 100% better than the amateur who has had no school instruction.

Commercial companies want amateurs with good training. Why not make your hobby your profession? Graduates of our course earn good money and expenses. Courses just starting. Moderate fees.

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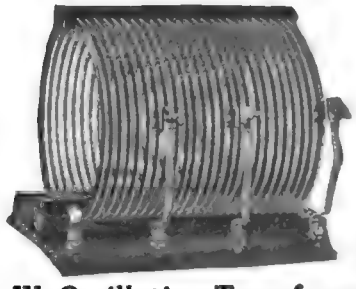

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$11.00

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The instructions given in the catalog enable the radio novice to place a Tube Transmitter into practical operation within a few hours after delivery of the equipment. Either telegraph or telephone communication can be obtained by connecting Radio Corporation sets directly to an A. C. power source.

The illustrations shown here cover a few of the Radio Corporation's C. W. accessories now available at your nearest dealer.

The Radio Corporation's C. W. Tube Transmitters consist of scientifically co-ordinated parts, which, when connected together provide a thoroughly reliable C. W. Tube Transmitter. All uncertainty of operation is eliminated.

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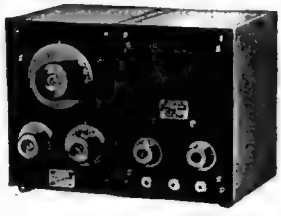

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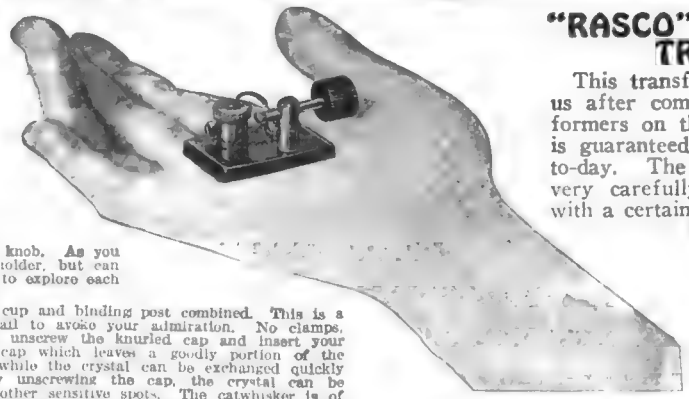
THE RASCO "BABY"



The smallest and most efficient detector in the world—as well as the cheapest. Our illustration is an actual photograph, and while the various details can be seen at a glance, we feel so enthusiastic about it that we must tell you all of its good points. First, there is a solid hard rubber composition base, size 1½" x 1½". We have not forgotten two holes to screw down the detector.

Then we have the nickel holder and binding post combined which holds the sliding, knurled, hard rubber composition knob. As you see, this knob not only revolves in its holder, but can also be moved back and forward in order to explore each point of the detector crystal.

Next we see the patent nickel detector cup and binding post combined. This is a little marvel all by itself and will not fail to evoke your admiration. No clamps, no soft metal to fuss with. You simply unscrew the knurled cap and insert your crystal into the stand, screw home the cap which leaves a goodly portion of the crystal exposed. The contact is perfect, while the crystal can be exchanged quickly in less than three seconds. By slightly unscrewing the cap, the crystal can be changed in position, in order to explore other sensitive spots. The catwhisker is of phosphor bronze and is attached to the horizontal bar by means of a filister head screw. Can be readily exchanged in less than two seconds. Wires can be connected to the binding post in a jiffy. All metal parts are nickel plated, and you will be proud of this little masterpiece.

No. 1898 Rasco Baby Detector complete with galena crystal, prepaid..... **50c**

No. 1899. The same but furnished with an additional piece of tested radiocite crystal, prepaid **75c**

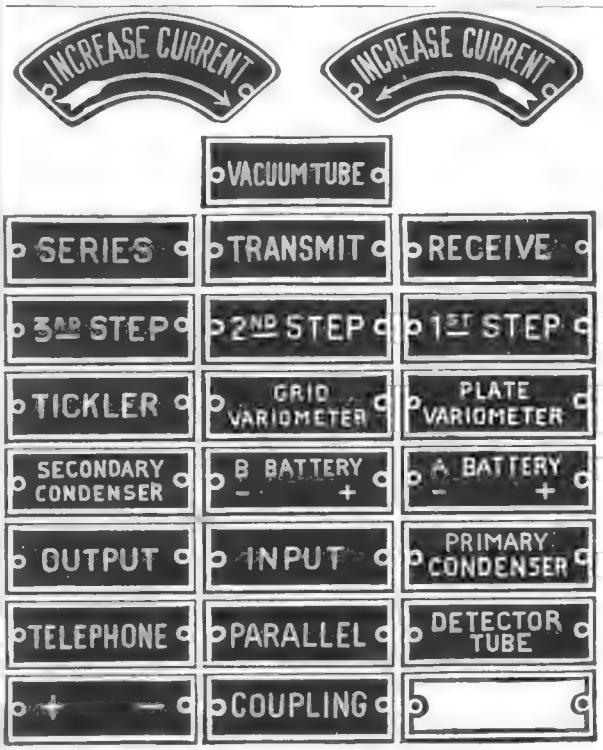
"RASCO" AUDIO FREQUENCY TRANSFORMER

This transformer has been developed by us after comparing all the various transformers on the market. This transformer is guaranteed to equal any on the market to-day. The primary and secondary are very carefully built and are impregnated with a certain wax in vacuum. The stampings are of the best silicon steel. Only the very best material is used throughout.

Realizing the fact that most amateurs desire to "make their own" we *furnish this transformer unassembled.* Directions which accompany the transformer are such that anyone can put the parts together in about ten to twelve minutes. This saves you considerable money, for the reason that manufacturers who assemble the transformers must charge you for the assembling work.

Illustration as shown is in full size. The weight complete is ten and one-half ounces. *Note also that we ship all goods prepaid.* **We pay the freight.**

No. 1100 "Rasco" Audio Frequency Transformer **NOT ASSEMBLED**, prepaid **$2.65**



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Our name plates are of brass with a black background. The name is nickel-plated, standing out well upon the black background. Illustrations are in full size. Each plate has two screw holes. Order by name.

The two top plates, "Increase current," list at 10c each, illustrations full size. All others are 5c each. We also have these not illustrated: Phones, Loading Coil, Aerial, Ground, Secondary, Primary, Audion, Detector, Off, On, each 5c. In dozen lots, 50c prepaid.

NEW. The white plate in the lower right-hand corner is blank, and made of such material that you can write your own lettering on it with pencil, ink, or China ink. Price each 5c.

WE GUARANTEE EVERY ORDER SHIPPED WITHIN 24 HOURS

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THE "RASCO" CATALOG A COLOSSAL EVENT

There are many radio catalogs, but the "Rasco" catalog marks a radical change for the simple reason that it

CONTAINS 50 VACUUM TUBE HOOK-UPS

This is the one and only radio catalog containing such wonderful free information. Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few.—The V.T. as a detector; detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; C.W. transmitters; self-rectifying 2 tube C.W. transmitter; V.T. transmitter with 6 volt battery; radiophone using plate and grid modulation; one tube radio transmitter and receiver; experimental radiophone; radiophone using Colpit oscillator circuit.

This list is only a partial one. You must positively see this wonderful book to appreciate it.

It is made to fit the pocket—has heavy covers to withstand the wear and tear which it is sure to have at your hands because it will be your constant companion.

And Oh yes! Before we forget it. If you are in need of the following remember "Rasco has it." These are only a few things contained in this catalog. **Lugs, Nuts, Dials, Knobs, Bakelite Sheets, Washers, Crystals, Litz Wire, Selenium, Cord Tips, Cap Nuts, Tin Foils, Name Plates, Spring Posts, Switch Parts, Metal Ribbon, Carbon Balls, Binding Posts, Switch Points, Switch Levers, Carbon Grains, Metal Pointers, Contact Points, Low Melting Metal, Carbon Diaphragms, Screws, Copper Strip, "Spaghetti" Name Plates, Sliders, Mica Switches, Resistance Wire, Variocoupler Rotors, Test Clips, Condenser Plates, Condensers, Antenna Connectors, Threaded Brass Rod, Ground Clamps, Etc., Etc.**

The catalog contains 200 illustrations. On account of its great cost, this catalog cannot be distributed free of charge. It will only be mailed upon receipt of **15c *in stamps or coin.***

Radio Specialty Co

Remember that this business was originated with the sole purpose to cater to the amateur who has small orders. **ALL OF OUR ORDERS ARE SMALL** and that is why your small order will never be side-tracked by us. A trial order will make you a life customer. You can order from the above illustrations. "We can only stick you once." Try us with a 50c order.

100 PARK PLACE, NEW YORK CITY *Factories: Brooklyn, N. Y.—Elkridge, Md.*

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The Glass City of To-morrow

By WILLIAM WALSH

(*Continued from page* 711)

groves of trees and between grass carpets of the brightest verdure. Electric fountains are playing on all sides. From various centers concealed lighting is diffused, throwing shadowless illumination with a marvelous similitude to golden sunshine.

Everywhere the people are drest as at a fashionable resort in July—the filmiest of lawns for the women and summer suitings for the men. None of the latter wear any hats. Why should they? There are none of the scorching rays of the sun, none of the sudden gusty, half-chilling breezes experienced outdoors, even in summer. On the other hand, there is none of the stifling enervation of the hot house, or of the steam-heated building. Children play about, big butterflies of brilliant coloring, imported from the tropics, dance and hover and float in the balmy artificial zephyrs that are indescribably soft and refreshing.

Millions of people are on the waiting list of those eager to take up their abode in this magic glass enclosed city. The value of property and the prices asked for rents are truly fabulous. Yet this city can house but a few thousand. To crowd it would be to take away its beauty and its charm.

This city is heated from one great central plant. This in itself is a relatively simple problem. Individual houses in various cities up to ten thousand population long have been taken care of in a similar manner, but a unique feature is the heating of the entire enclosure within the walls and roof of glass. Another unique feature is that no dwelling has its own radiators. Giant radiators take care of that problem also. Everywhere underneath the dome the temperature is uniform—hovering around seventy degrees. For those who are enfeebled or accustomed to bask in super-heated rooms individual heaters are furnished. The presence of one of these in a home is, however, quite rare.

Telephone, telegraph and radio link the enchanted city with the outside world and other glass-enclosed cities.

Ventilation is accomplished by openings at intervals in the surface of the glass dome and by setting in operation here and there great fans. By this latter method delicate perfumes—literally scented breezes—are wafted thru the city. Great electric ozonators masked in tropical vegetation are also of prime importance in keeping the atmosphere fresh and pure.

The parks of this city at night are a lover's paradise—with the gentle warmth of the air, the delicious scent of the innumerable roses, the lagoons with their noiselessly operated electric boats, and over this scene the soft silver light of artificial moonshine. Ludwig, King of Bavaria, had a moon built at a cost of over $100,000. But the illuminating engineer has so far advanced that the potentialities of light are almost limitless. These illuminating experts make Ludwig's moon pale into the insignificance of the firefly's glow.

There are no flies, no mosquitoes, no insect life of any kind in this crystal city. All the luxuries and grandeur of the Orient, all the conveniences and comforts of the Occident, all the mystery and magic that the poets have sung thru the ages, Man here finds realized. Such a city the poet Coleridge must have seen in his dreams when he wrote:

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A New Color-Music Instrument

By EDWIN HAYNES

(*Continued from page 701*)

of motion pictures. This wire conducts the sound waves, received by the microphone, to a compartment of the instrument. In this compartment are arranged several tuning forks, each one of which responds to the note of the musical scale represented by it and to that note only. When this note ceases to be sounded the fork attuned to that tone ceases to vibrate. If several tones are sounded, several of the forks vibrate simultaneously. This instrument is called the resonator.

The vibrations of the prongs opening and closing each its own circuit are electrically conveyed from the resonator to another compartment of the mechanism, in which are serially arranged color fragments corresponding to the several colors of the color scale. Responsive to the vibrations of the forks the color fragments fall into position at an aperture thru which an electric light, located posteriorly in line with it, is projected. Any number of color fragments necessary to represent the several tones being sounded simultaneously are engaged at the same time without interference and make a full translation of the music—vocal or instrumental, produced separately or in combination.

These colors are all carried forward into a geometroscope, as it is termed, which is a device of special construction patented by the inventor. The geometroscope is an instrument for producing automatically an almost infinite variety of combinations of color and forms, from small objects introduced, and is used for making designs for the industrial arts.

As adapted to the production of color music the geometroscope produces similar results, causing the colors, transmitted from the color fragments, to form a multitudinous variety of patterns, composed of colored geometric figures, symmetrically combined. The predominating color of the combination corresponds to the dominating color of the music being translated.

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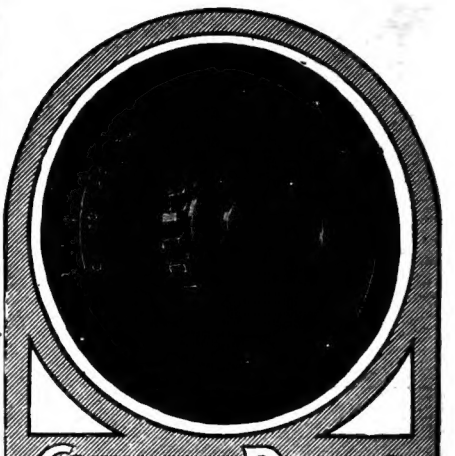

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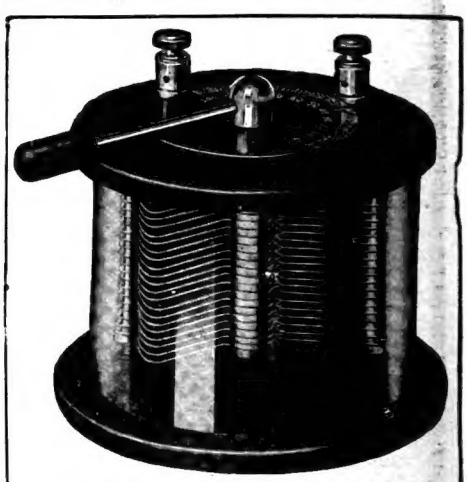

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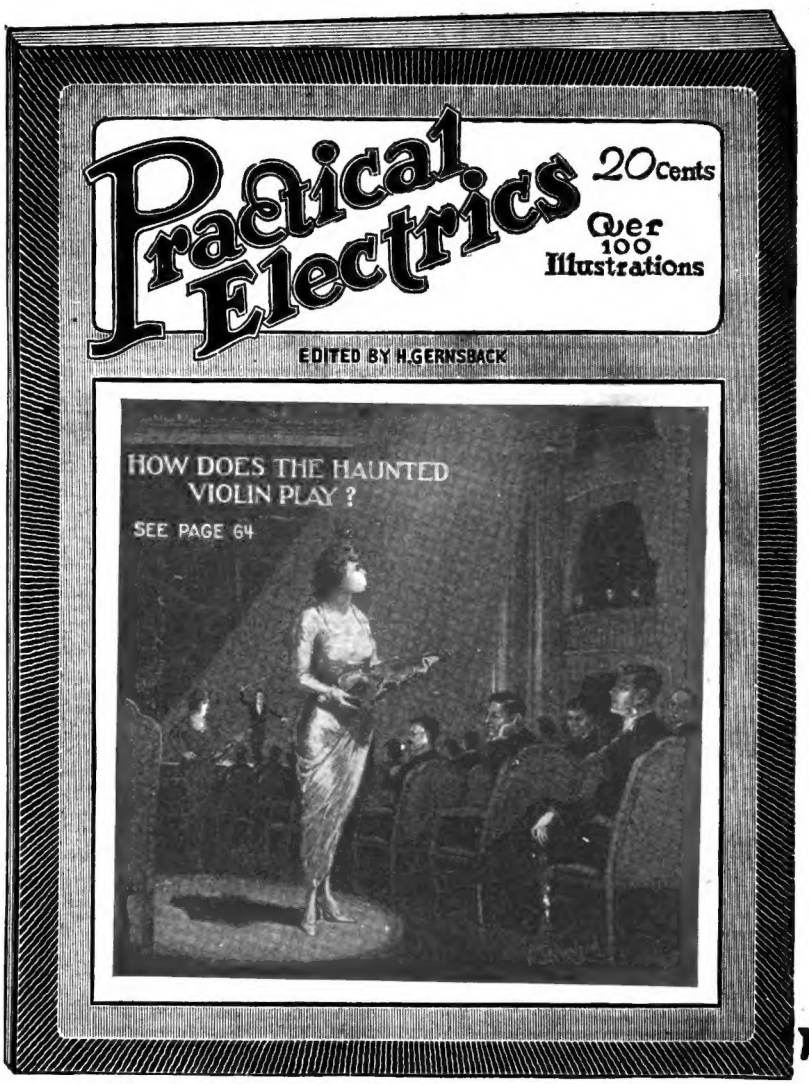

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